PREFEASIBILITY STUDY
OF MINI-HYDRO POTENTIAL
IN THE VICINITY OF WASKAGANISH, QUEBEC

PREFEASIBILITY STUDY OF MINI-HYDRO POTENTIAL IN THE VICINITY OF WASKAGANISH*, QUEBEC

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Cree Regional Authority

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*Formerly known as Rupert House and Fort Rupert

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TABLE OF CONTENTS

		PAGE
	EXECUTIVE SUMMARY	v
	RESUME	vii
1.	INTRODUCTION	1
1.1	General	1
1.2	Purpose of the study	2
2.	CONCLUSIONS AND FURTHER STUDIES	3
2.1	General	3
2.2	Conclusions	3
3.3	Investigations required prior to further studies	4
3.	STUDIES	5
3.1	Basic data	5
3.1.1	General description of the region	5
3.1.2	Access	5
3.1.3	Mapping	6
3.1.4	Geology	6
3.1.5	Hydrology	7
3.1.6	Power and energy requirements	7
3.2	Site selection	9
3.2.1	Criteria for site selection	9
3.2.2	Preliminary site inventory	10
3.2.3	Field survey	11
3.2.4	Preliminary site optimization	12
4.	RECOMMENDED DEVELOPMENT - SITE "r3"	13
4.1	Site description	13
4.2	Proposed layout	15
4.3	Hydrological studies	15
4.4	Generating equipment	21
4.4.1	Selection of units type	21
4.4.2	Base load requirement (1000 kW)	21
4.4.3	Total demand (5700 kW)	21
4.5	Power transmission and distribution	22
4.5.1	Base load requirement (1000 kW)	22
4.5.2	Total demand (5700 kW)	23
4.6	Sequence of construction	23
4.7	Plant operation	24
4.8	Ice conditions	24
5.	COST ESTIMATES	26
5.1	Criteria	26
5.2	Total cost	27
6.	BIBLIOGRAPHY	29
7.	DRAWINGS	
	Plate n° 1 Location plan, site inventory	30
	Plate n° 2 "r3" General layout, details, ice cover cartography	31

TABLE OF CONTENTS (Cont'd)

		PAGE
8.	ANNEX A - SITE INVESTIGATION DATA SHEETS	32
	Site r1	32
	Site r2	36
	Site r3	40
	Site p1	44
	Site p2	48
	Site p3	52
	Site p4	56
	Site p5	60
	Site p6	64
	Site b1	68
	Site b2	72
9.	ANNEX B - ADDITIONAL INFORMATION	76

PREFEASIBILITY STUDY OF MINI-HYDRO POTENTIAL IN THE VICINITY OF WASKAGANISH, QUEBEC

Executive Summary

The community of Rupert House is seeking the most economical and socially accepted source of energy supply to satisfy its forecasted demand for the next 50 years.

Rupert House, located at the mouth of the Rupert River, is accessible by boat via James Bay during the open navigation season, by plane via scheduled flights of Air Creebec or by helicopter. For the benefit of the building activity in the community, a winter road is maintained from the village to Matagami-LG2 road. A segment of this road--its first 20 km--represents a permanent access road to the sand barrow pit presently under exploitation.

This report considers the possibility of developing mini-hydro plants at six sites on the Pontax River, three sites on the Rupert and two on tributaries of the Broadback.

The study found that the most favorable site is located on the Rupert River at Kaoposcuan Sibostak, some 35 km from the village. It would require an initial investment evaluated at $10,600,000 for a 1 MW capacity station and would cost $25,500,000 for a 5.7 MW development.

A big part of the investment is to cover the costs of a new access road and a transmission line (a minimum of $4,400,000 in direct costs only).

Supplementary justification for opening the access road, such as the wood supply activity or even a permanent link to the Matagami-LG2 road, would be an incentive toward the development of a mini-hydro energy source.

The study was undertaken by Asselin, Benoit, Boucher, Ducharme, Lapointe Inc. of Montreal for the Cree Regional Authority with a contribution from the Remote Community Demonstration Program of Energy, Mines and Resources Canada.

A comparison study, entitled "A Comparative Study of Energy Systems for Waskaganish, Quebec", analyzes the community's energy options.

*Waskaganish was formerly known as Rupert House and Fort Rupert.

PRE-ETUDE DE FAISABILITE D'UNE MINI-CENTRALE HYDRO-ELECTRIQUE AU VOISINAGE DE WASKAGANISH (QUEBEC)

Résumé

La localité de Rupert House cherche la source d'énergie la plus acceptable de double point de vue économique et social pour répondre à ses besoins au cours des 50 prochaines années.

Rupert House est située à l'embouchure de la rivière Rupert. On peut s'y rendre en bateau par la Baie James lorsque les eaux sont libres, en avion par les vols à horaire fixe de la compagnie Air Creebec ou en hélicoptère. Aux fins des travaux de construction, on entretient un chemin d'hiver entre le village et la route Matagami-LG2. Un tronçon de cette route (les 20 premiers kilomètres) constitue une voie d'accès permanente à la carrière de sable actuellement en exploitation.

Les auteurs de ce rapport étudient la possibilité de construire une mini-centrale hydro-électrique; ils ont retenu six endroits sur la rivière Pontax, trois sur la Rupert et deux sur des tributaires de la Broadback.

L'étude démontre que le lieu le plus propice se trouve sur la rivière Rupert à Kaoposcuan Sibostak, à environ 35 km du village. Il faudrait un investissement initial de 10 600 000 $ pour y construire une centrale de 1 MW, et de 25 500 000 $ pour en construire une de 5,7 MW.

Une bonne partie de l'investissement servirait à construire une nouvelle voie d'accès et une ligne de transport de l'électricité (au moins 4 400 000 $ en coûts directs seulement).

L'aménagement d'une voie d'accès, du même coup, faciliterait les travaux d'approvisionnement en bois et même créerait un lien permanent entre la localité et la route Matagami-LG2, autant d'arguments qui militent en faveur de la construction d'une mini-centrale hydro-électrique.

L'étude a été exécutée par la firme Asselin, Benoît, Boucher, Ducharme, Lapointe Inc. de Montréal à la demande de l'administration régionale des Cris, à la faveur d'une subvention du Programme de démonstration dans les collectivités éloignées du ministère de l'Energie, des Mines et des Ressources du Canada.

Une étude complémentaire, intitulée "Une étude comparative des systèmes énergétiques pour Waskaganish (Québec)", analyse les différentes options énergétiques pour la collectivité.

*Waskaganish était anciennement connu sous les noms de Fort Rupert et Rupert House.

1. INTRODUCTION

1.1 General

The community of Rupert House is seeking the most economical and socially accepted source of power and energy supply to satisfy its forecasted demand for the next 50 years.

Today, Rupert House relies on the electricity generated by diesel-powered units, and, for heating it depends on wood or oil.

The recently built diesel generating station is equipped with two 800 kW and two 250 kW units. The distribution network capacity and the wiring of the new houses as well as that of the residences under construction are not planned in terms of an all-electric concept.

Potential energy sources available to Rupert House are hydro power produced by local mini-hydro, thermal generation by oil or wood and direct connection to the Hydro Quebec grid.

By commissioning a comprehensive energy study, the Band Council of Rupert House is seeking information and recommendations to be used when it decides to choose a proper scenario for the village.

1.2 Purpose of the study

The terms of reference are divided in two parts. The first part[1] is a prefeasibility study of the mini-hydro potential around Rupert House. Part two[2] addresses energy consumption projections, the different scenarios available and the costs.

This report pertains only to the first part and considers the possibility of developing mini-hydro plants on the Pontax, Rupert and Broadback Rivers. The most promising site is identified, and its development is evaluated with the help of a preliminary layout, summary details of the various structures and a cost schedule. Mapping and field investigations required for further studies are identified.

[1] This report

[2] A companion report, under the title "A Comparative Study of Energy Systems for Waskaganish, Quebec".

2. CONCLUSIONS AND FURTHER STUDIES

2.1 General

The area around Rupert House presents a concentration of three major watercourses, namely the Pontax, Rupert and Broadback Rivers.

All potential sites on these rivers located in a 50 km radius were considered.

The Hydro-Quebec project, known as the NBR Complex, is not part of the Crown Corporation present construction program, which covers the next 20 years.

2.2 Conclusions

The most favorable site "r3" is located on the Rupert River at Kaoposcuan Sibostak, some 35 km from the village. It requires an initial investment evaluated at $ 10 600 000 for a 1 MW capacity station and would cost $25 500 000 for a 5,7 MW development.

A big part of the investment is covering the costs of the new access road and the transmission line (a minimum of $4 400 000 in direct costs only).

Supplementary justification for opening the access road, such as the wood supply activity or even a permanent link to the Matagami - LG2 road, would be an incentive toward the development of a mini hydro energy source.

The potential of this site satisfies at least the projected basic electrical requirements of the community for the next twenty years.

2.3 Investigations required prior to further studies

As mentioned earlier, the "r3" site looks the most promising, but further information is required for future stages of the study.

An investigation program concerning the ice conditions is required and could preferably be carried out during the 1983-1984 winter. The investigation would dissipate doubts regarding the frazil accumulation at the inlet of the secondary branch of the Rupert River at the proposed site. It should be completed before any further studies are carried out on this site.

Only a positive result from the above-mentioned program could lead to the feasibility study including an optimisation of the installed capacity at "r3", in accordance with the final results of the energy study.

An investigation program to obtain the topographical, geological and hydrological data needed for the next stages of the project, should be implemented once the ice and frazil conditions of the site are known.

3. STUDIES

3.1 Basic data

3.1.1 General description of the region

The region surrounding the Rupert House community is crossed in a general east-west direction by three parallel watercourses, the Pontax, Rupert and Broadback Rivers which discharge in the Rupert Bay at locations only 15 km apart. Due to this closeness, the elongated shape of their respective watersheds does not allow enough space for major tributaries to develop.

The longitudinal profiles along the riverbeds show the typical long gentle sloped stretches interrupted by rapids, but there is no significant concentrated drop in a 50 km radius around the village.

The topography of the region is plateau like, with an average elevation of 30 m above sea level.

3.1.2 Access

Rupert House, located at the mouth of the Rupert River, is accessible by boat via the James Bay during the open navigation season, by plane via the scheduled flights of Air Creebec or by helicopter. Presently, for the benefit of the building activity in the community, a winter road is maintained from the village to the Matagami - LG2 road. A segment of this road, its first 20 km, represents a permanent access road to the sand borrow pit presently under exploitation.

3.1.3 Mapping

The Rupert House region is mapped by the Department of Energy, Mines and Resources at a 1:50000 scale with contour interval of 50 feet.

More detailed topographical maps of the Quebec ministère des Ressources Hydrauliques at the 1:12000 scale and contour interval of 20 feet are available for the Fort Rupert vicinity.

The Rupert and Broadback valleys are covered by maps prepared by Hydro-Quebec at the 1:20000 scale and 5 feet contour interval. For some of the sites investigated and located close to the future Hydro-Quebec projects, mapping at the 1:5000 scale is available.

3.1.4 Geology

Basic geological data pertaining to the region exist in the form of various provincial and federal publications. The area is also covered by regular east-west running aerial photographic survey lines carried out by the ministère des Terres et Forêts and the ministère de l'Énergie et des Ressources, Service de la Cartographie, Gouvernement du Québec, on a 1:15840 scale. In addition, the Société d'Énergie de la Baie James has carried out their own aerial photographic survey and interpretation in the areas of Rupert and Broadback Rivers on a 1:12000 scale.

The area belongs to the Canadian Shield and has a granitic type of bedrock erroded by the glaciers which left in place various deposits of moraine covered eventually by marine clay.

3.1.5 Hydrology

The area covered by the study belongs to the 08 hydrographical region and was under intense scrutiny for the last 12 years in relation with the NBR development.

Streamflow measurements have been recorded on the Pontax River during 6 years at station n° 081101.

The Rupert River with three stations has streamflow records for up to 20 years and level measurements at Mistassini and Nemiscau Lakes for up to 34 years.

The two stations on the Broadback River have records for 28 years.

All this basic data and the area of the drainage basins are available from Quebec Government publications. Based on the above information the Société d'Énergie de la Baie James has undertaken hydrological studies which are mentioned in the reference list.

Ice surveys were conducted on the Rupert and Broadback rivers in 1972 by Hydro Quebec and studies on the ice cover were completed in 1978 by SEBJ. No measurements were taken at that time on the stretch of the Rupert River between km 29 and 45 where the "r3" site is located.

3.1.6 Power and energy requirements

This information is being analyzed in the second tier of the study covering the energy consumption projections. Preliminary results are summarized in table 1.

TABLE 1
PEAK ELECTRICAL DEMAND

Year	1983	1992	2002	2012	2032
Basic requirement (kW)	433	560	657	760	1000
Heating (kW)	2511	3387	4038	4652	6400
Total (kW)	2944	3947	4695	5412	7400

By taking into account the losses by transmission and the in-house requirements of the powerhouse, the peak electrical generation required is given in Table 2.

TABLE 2
PEAK ELECTRICAL GENERATION

Year	1983	1992	2002	2012	2032
Basic requirement (kW)	600	650	750	860	1100
Heating (kW)	2640	3560	4240	4880	6720
Total (kW)	3240	4210	4990	5740	7820

The basic requirements cover mainly the domestic consumption for cooking, washing, lighting and functionning of the usual home appliances. Added to that are the similar type of consumptions in the commercial and institutional sector and of course the village public lighting system.

According to the latest data, the highest peak demand at the existing diesel power station was 715 kW in March 1983. It should be mentioned that only part of it could be characterized as basic requirement.

For the study purposes, two installed capacities were considered:

- a 1 MW installed capacity corresponding to the basic requirements in the next 30 years, which should provide a valid input for the alternatives in the energy study analyzing other sources of heating (oil, wood, etc.);

- a 5,7 MW installed capacity covering the total demand over the same period of time and providing the information for the scenario where the only source is hydro-electric in nature.

3.2 Site selection

3.2.1 Criteria for site selection

In establishing the potential sites inventory, the following criteria were retained:

a) distance from the community; the search was limited to a 50 km radius around Rupert House;

b) flow availability; major rivers or tributaries were taken into consideration;

c) river slope; rapids or natural falls were retained for investigation;

d) topographical and geological conditions; the river width, the shape of the stream bed and soundness of foundations were considered;

e) general access; the existence of roads or the conditions favorable to the opening of a permanent road were recorded;

f) future development by others in the area; a review of projects which could affect a mini- hydro development was undertaken.

3.2.2 Preliminary site inventory (Plate n° 1)

Based on the above-mentioned criteria, a total number of eleven sites were identified on 1:50000 maps. Six were located on the Pontax River, three on the Rupert River or in the vicinity of Rupert House, and two on tributaries of the Broadback River.

The Pontax River, which will not be the object of future power development by Hydro Quebec and is the less known of the three rivers considered for study, was specially investigated. The rapids were all considered as potential sites and the search went as far as up to the "p6" location (at 61 km from the river mouth), because of the presence of waterfalls.

On the Rupert River, the previously proposed site at km 24 was not even considered, because of the frazil accumulation revealed during the 1972 ice survey. The "r1" (Pouget River) and "r2" sites were included in the inventory despite their small catchment areas, because of their proximity to Rupert House.

On the Broadback River, the selection of sites was made taking into account the construction of the future "B1" and "B2" developments. The "b1" (Lepalier River) and "b2" (Natouacamisie River) site locations were chosen outside the perimeter of the future "B1" reservoir.

3.2.3 Field survey

The inventory of potential sites was subjected to a reconnaissace survey by helicopter on July 20, 1983. The detailed information gathered then is presented in the data sheets attached and photographic records are on file and available on request. The following remarks could be made:

- the longitudinal profiles of the Pontax River rapids have a very gentle slope of 0.5%. The only exception is "p6" where a concentrated drop of around 10 m is available;

- the first two sites, "p1" and "p2", are located in very large and meandering stretches of the Pontax River;

- the geological conditions are favorable at the "p6" and "r3" sites. Some locations, especially "r1", "r2", "b1" and "b2" are cut in the clay deposit and present fresh slides;

- the "r3" site at Kaoposcuan Sibostak benefits from the natural configuration which provides for a 2 km long intake canal. No sounding was made in this secondary branch of the river to assess its flow capacity;

- none of the surveyed sites would be subjected to adverse environmental impact if developped.

3.2.4 Preliminary site optimization

Based on the criteria for site selection and on the findings of the aerial survey, a preliminary selection has been made.

All sites, with the exception of those along the Rupert River, require long access roads, transmission lines and crossing of major rivers.

The "r1" and "r2" locations, despite their vicinity to the consumption center, suffer from low waterflow and poor geological conditions.

The "b1" and "b2" sites have an added drawback caused by the future "B1" reservoir which limits considerably the usable head.

The "r3" location has a natural configuration which favors a mini-hydro development, sound geological conditions and part of the access road is already built.

Because of the major drawbacks of all other alternatives detailed studies were concentrated on the "r3" site which is considered the most promising.

4. RECOMMENDED DEVELOPMENT - SITE "r3" (Plate n° 2)

4.1 Site Description

Between km 31,5 and km 34 of the Rupert River, the course is split into a main branch to the north and a secondary branch to the south (see figure 1).

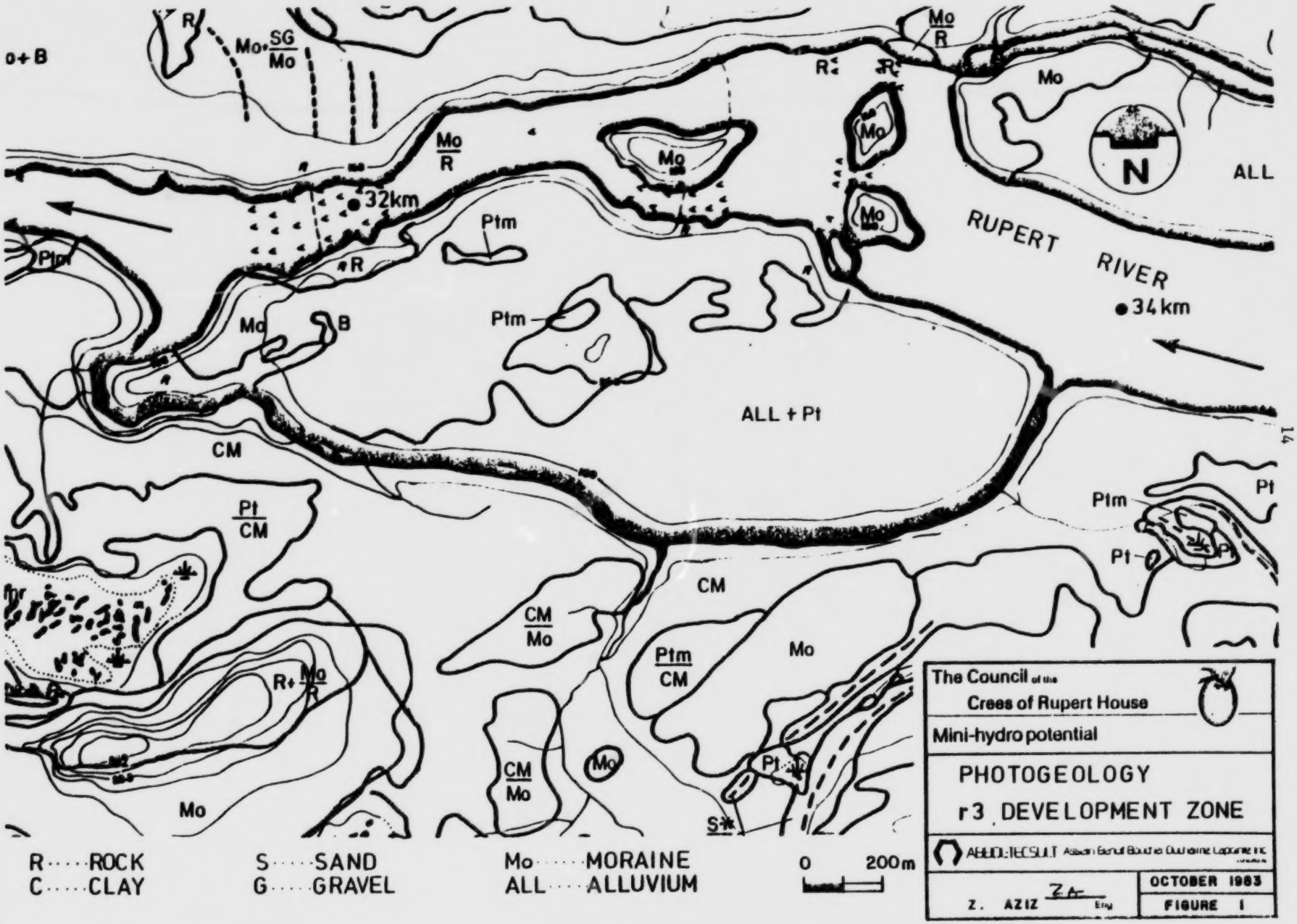
Since the river profile in this section provides a 8 m head, the existence of the secondary branch has been considered very promising for a mini hydro-electric scheme. This stretch of river known as Kasposcuan Sibostak, has been identified as site "r3".

The powerhouse is located at the downstream tip of the island created between the main course of the Rupert River and the left side secondary branch.

The main river flows for several kilometers through a rock controlled rapids section. Meanwhile, the secondary branch flows for 2 km in a natural clay filled channel, which only in its final section falls back in the main course along a U shaped stretch of rocky steps.

On the western third of the island the bedrock is visible on the banks, in some outcrop and is quite close to the surface.

On the eastern part, more important deposits of alluvium, moraine and blocks are present. A more detailed image of the geology is shown in figure n° 1 which is part of the photo interpretation carried out by SEBJ in 1976 (see SEBJ drawings ZA-01G-003-00-AO-AA and ZA-01G-004-00-AO-AA).


o+B
R
Mo+SG/Mo
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R
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ALL
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Ptm/CM
Mo
R+Mo/R
CM/Mo
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Mo
S
R·····ROCK
C·····CLAY
S·····SAND
G·····GRAVEL
Mo·····MORAINE
ALL····ALLUVIUM
0
200m
The Council of the Crees of Rupert House
Mini-hydro potential
PHOTOGEOLOGY
r3 DEVELOPMENT ZONE
ABITIBI-TECSULT Abitibi Consul Boucher Ouellette Lapointe Inc.
Z. AZIZ
OCTOBER 1983
FIGURE 1

4.2 Proposed layout

The scheme is a typical run-of-the-river diversion plant taking full advantage of the natural channel existing on the left bank.

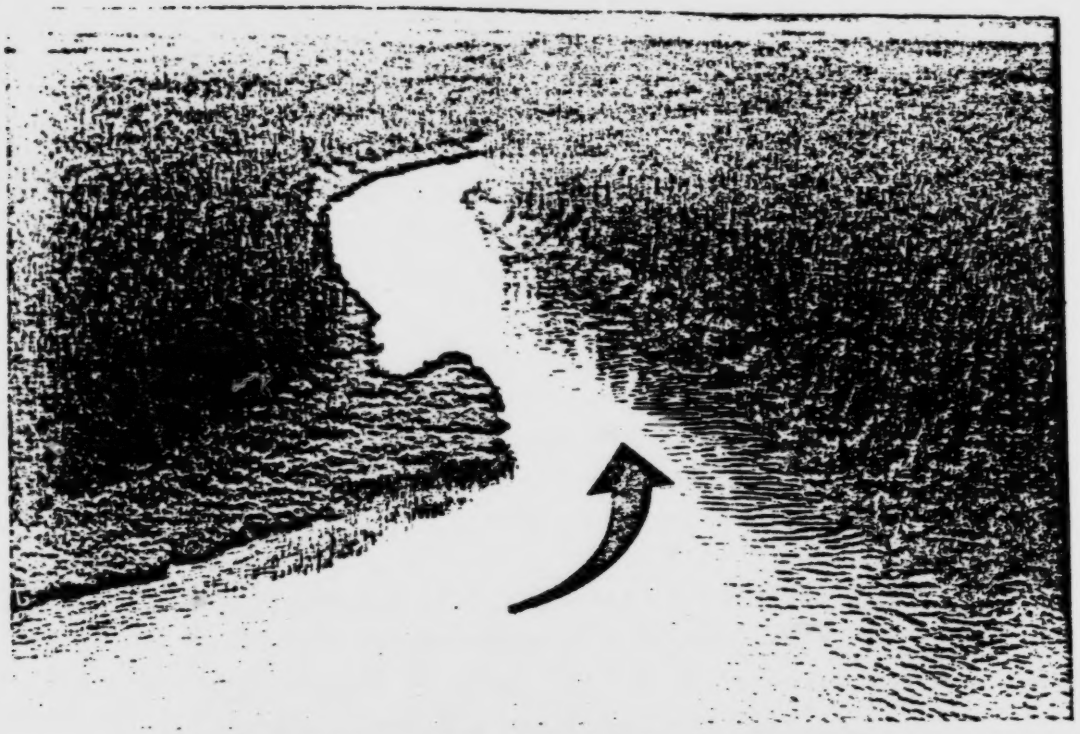
By blocking this secondary branch and excavating a relatively short canal across the tip of the island, the upstream level is transferred close to the intake and the approximate 8 m total head is concentrated at the powerhouse (see the following photographs).

A partial blocking of the main river by a jetty ensures that enough water enters the secondary banch, even at the lowest flow. It also ensures that the velocity conditions for the formation and stability of the ice cover are met.

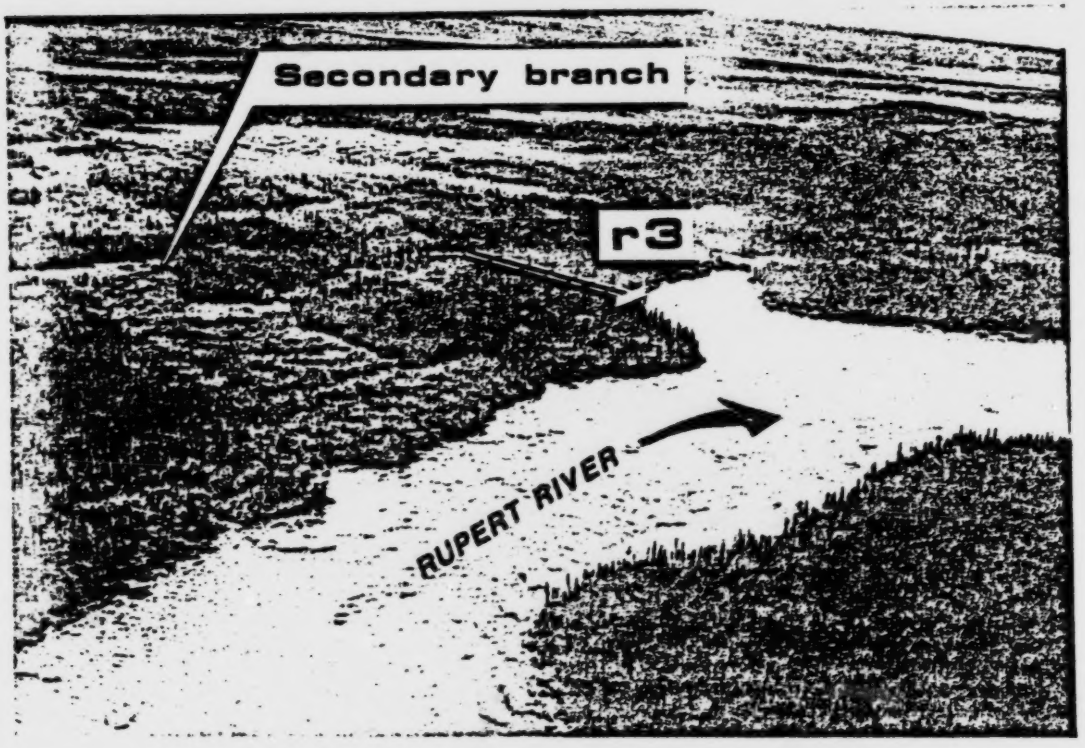
If the NBR Complex were built and the Rupert River diverted, a full closure of the river bed is required at "r3". A structure located on the jetty axis is part of the mitigating measures which must be taken by SEBJ for environmental purposes and could take care of this closure with minimal extra costs for the mini-hydro development. The weir would form a reservoir which could reach an active storage of around 25 000 000 m^3.

4.3 Hydrological studies

The hydrology of the Rupert River is well known and some of the available information is shown in Tables 3, 4 and 5 which are based on the reference (4).



SECONDARY BRANCH INLET



KAOPOSCUAN SIBOSTAK SITE

At the "r3" site the minimum natural flow exceeds 300 m^3/s and the minimum residual flow, once the NBR Complex is built, exceeds 7 m^3/s.

Assuming a 6,5 m head, the total firm power potential available would be around 15 MW.

As previously mentioned, the layout of "r3" is such that the main course is left unblocked so the natural flow is not hindered. Therefore no detailed studies were made yet on the magnitude or frequency of the floods which are quite significant (e.g. the 1:50 value is around 2700 m^3/s).

TABLE 3

RUPERT RIVER

MONTHLY AVERAGE FLOWS (m^3/s)

	FLOW AT ST. #081002 (Nemiscau)	FLOW AT RUPERT HOUSE		FLOW AT "r3" (R.H. -1/3)
JANUARY	660	692	32	682
FEBRUARY	515	540	25	532
MARCH	421	442	21	435
APRIL	452	477	25	472
MAY	1031	1103	72	1079
JUNE	1177	1264	81	1245
JULY	1053	1125	72	1116
AUGUST	1008	1056	48	1041
SEPTEMBER	1036	1086	50	1070
OCTOBER	1100	1155	55	1137
NOVEMBER	1020	1074	54	1056
DECEMBER	638	880	42	866

TABLE 4

RUPERT RIVER

MONTHLY MINIMAL FLOWS (m^3/s)

	FLOW AT RUPERT HOUSE	Corr. factor*	FLOW AT "r3"
JANUARY	519	0.986	512
FEBRUARY	377	0.985	371
MARCH	345	0.984	339
APRIL	371	0.990	367
MAY	651	0.978	637
JUNE	766	0.925	755
JULY	723	0.992	717
AUGUST	650	0.926	641
SEPTEMBER	659	0.985	649
OCTOBER	844	0.984	830
NOVEMBER	837	0.983	823
DECEMBER	657	0.984	646

* Same correction as for average flow

TABLE 5

RUPERT RIVER

MEAN MONTHLY RESIDUAL FLOWS in (m^3/s)

Total Drainage Basin: 43 234 km^2

Residual Drainage Basin: 2 331 km^2

	FLOW AT RUPER HOUSE	FLOW AT "r3" $\frac{2}{3}$ x Qtot
JANUARY	17 @ 30,9	11,2 @ 20,4
FEBRUARY	12 @ 27,6	7,9 @ 18,2
MARCH	10 @ 22,6	6,6 @ 14,9
APRIL	23 @ 26,2	15,2 @ 17,3
MAY	55,3 @ 87,0	36,5 @ 57,4
JUNE	63,0 @ 104,9	41,6 @ 69,2
JULY	42 @ 88,9	27,7 @ 58,7
AUGUST	38 @ 54,0	25,1 @ 35,6
SEPTEMBER	39 @ 55,5	25,7 @ 46,6
OCTOBER	52 @ 59,0	34,3 @ 38,9
NOVEMBER	42 @ 54,7	27,7 @ 36,1
DECEMBER	28 @ 45,0	18,5 @ 29,7
AVERAGE	37,8 @ 51,6	24,9 @ 34,0

4.4 Generating equipment

4.4.1 Selection of units type

Axial flow turbines with horizontal axis are well suited for the net head of 6,5 m available at site "r3". However, cross flow turbines would also provide satisfactory operation under 6,5 m head, but this alternative is limited by the largest standard size available.

The units are completed with synchronous generators, speed increasers, flywheel, governors and brushless excitation.

4.4.2 Base load requirement (1000 kW)

In order to satisfy the base load, it is proposed to install 2 units 350 kw each, for the initial stage of development. A third 350 kW unit would be added during the final stage.

These units could be of the cross-flow or S-shape tube type, which are widely used in such projects.

The alternators are rated at 400 kVA and generate at 4,16 kV, 3Ø, 60 Hz and 0,9 power factor.

4.4.3 Total demand (5700 kW)

If basic loads and heating loads have to be satisfied, it is proposed to install three (3) S-type turbines in the initial stage, one 850 kW unit and two 1600 kW units. In the second stage, a third 1600 kW unit would be added.

It should be noted that two different sizes of units are proposed to provide a satisfactory operation under base load only.

For this alternative, only S-shape tube units have been considered because the maximum unit capacity for cross-flow turbines is limited to approximmately 350 kW under 6,5 m head.

The alternators are rated at 1800 kVA and 950 kVA respectively and are provided to generate at 4,16 kV, 3Ø, 60 Hz and 0,9 power factor.

4.5 Power Transmission and Distribution

4.5.1 Base load requirement (1000 kW)

Substation

The step-up substation, located near the power-house, consists of three single-phase transformers rated at 333 kVA each, 4,16/25 kV, complete with fused load interrupters and all the protection necessary for the safety and the reliability of the substation.

Transmission line

The 25 kV voltage of the transmission line was found to be the most economical, taking into consideration the load to be transmitted and the length of the line. Maximum line losses will be around 4.3% at full load.

The transmission line consists of a single circuit, 35 km long, on wooden poles.

4.5.2 Total demand (5700 kW)

Substations

The step-up substation, located near the power-house, consists of three single-phase transformers, rated at 2000 kVA each, 4,16/69 kV, complete with fused load interrupters and all the protection necessary for the safety and reliability of the substation.

Another substation located at Rupert House steps-down the curent to a distribution voltage of 25 kV. It consists of a fused load interrupter, three single-phase transformers 2000 kVA each, 69/25 kV and all other protection equipment.

Transmission line

The voltage of the transmission line in this alternative was chosen at 69 kV due to the increase in the load.

The transmission line consists also of a single circuit 35 km long, mounted on wooden poles.

4.6 Sequence of construction

The general layout which takes into consideration the natural features of the site allows for a simple sequence of construction.

By closing the secondary branch inlet with a cofferdam, all the construction could be done in dry conditions. Downstream, at the powerhouse, a rock plug left

in place along the shore line creates the same favorable conditions in that area.

The jetty, which is only a pervious diversion element, could be built in a short period of time under low water conditions.

4.7 Plant operation

The powerhouse is automatically operated but the access road should be permanently open for periodical visits of a maintenance crew or in case of emergency.

When the available supply of energy from the river exceeds the power demand, the units are controlled only by speed governors.

4.8 Ice conditions

Ice conditions in the area have been studied extensively by ABBDL for SEBJ's NBR Complex (see reference (5)).

The ice cover forms in December and January by jamming of the ice sheet between the border ice. The ice cover at the side channel inlet is believed to reach in march a thickness of 1 to 1,5 m of solid ice. Frazil accumulation is not believed to take place in front of the channel entrance, as most of the frazil generated in the upstream rapids at km 48 and 64 accumulates under the ice cover upstream. Drawing n° ZA-01H-134-00-BO-AH of the above-mentioned study shows ice cover conditions as found by analyzing "Landsat" satellite pictures taken in the winter of 1976. Part of it is reproduced on plate n° 2.

Theoretical calculations also indicate that the ice cover can progress upstream of "r3" by juxtaposition of ice floes forming an ice sheet 10 to 15 cm thick produced by frazil flocks generated in a patch of open water located at km 40. The ice cover forms over this patch of open water late in December or early in January, thus eliminating frazil production.

Ice investigations are recommended for the coming winter to confirm that frazil generated in the upstream rapids does not accumulate under the cover down to the channel inlet. These investigations would consist of measuring river cross sections downstream and upstream of the channel inlet as well as in the channel itself. Six cross-sections shown on plate n°2 should be measured at least three times during winter i.e. in mid-January, mid-March and mid-April. This work could be done by the consultant assisted by workers from Rupert House or by an ice survey crew from SEBJ based in LG-2. In this case, Band Council would make the necessary arrangements with SEBJ.

5. COST ESTIMATES

5.1 Criteria

The following criteria were assumed in order to estimate the total cost of the development:

- Access: as mentioned before, existing permanent access to Rupert House is by boat, small airplanes or helicopter. A new road approximately 15 km in length has to be built to the site. During the construction period, the maintenance of a winter road to the Matagami - LG2 artery is considered;

- Camp and facilities: due to the location of the site, one camp has to be developped in that area. Daily commuting from the village is feasible in order to accomodate part of the locally hired work force;

- Borrow areas: no borrow areas were specifically investigated, except the one presently exploited by the village. This borrow pit in conjunction with others considered for the NBR's "R3" site in the late 70's, could be used as a source of moraine, sand and gravel. Rock could be quarried on the island;

- quantities: the accuracy of the take-offs is limited to the precision of the available mapping and the minimal design corresponding to this stage of the project. The total absence of bathymetry in that zone is a definite drawback,

which should be corrected if further studies are contemplated;

- direct costs: most unit costs were bid figures from projects monitored by SEBJ and built in similar conditions. Specialized manufacturers of generating equipment (Dominion Bridge-Sulzer and F.W.E. Stapenhorst) supplied budget prices;

- indirect costs and contingencies: they were considered as a percentage of the direct costs and amount to more than 45%. The indirect costs include the expenses for camp facilities, and the fees for engineering and management. The contingencies cover the unknown factors encountered in the estimation process (minimal information available, degree of accuracy in the evaluation of quantities, unforseen elements etc).

5.2 Total cost

The civil works were considered in place from the very beginning for the final capacity of the projects, but the installation of the third or fourth turbine respectively could be delayed for up to 10 to 20 years.

The costs given in Table 6 are calculated in $ 1983 and represent the cost break-down for the projects, excluding the local distribution.

The third turbines for the second phase are evaluated at $800 000 and $1 400 000 respectively.

TABLE 6

TOTAL COSTS

		1 MW ($1000)	5,7 MW ($1000)
1. Access	Permament road	1 500	1 500
	Winter road	1 040	1 040
2. Diversion works (jetty, canal, main dam, cofferdam)		525	4 240
3. Civil works (intake, powerhouse)		650	3 700
4. Turbines and generators (including auxiliary equipment)		1 700	4 325
5. Transmission line (including switchyard)		1 860	2 500
	Total construction Costs	7 275	17 300
	Indirect Costs	1 925	4 650
	Contingency	1 400	3 550
	TOTAL	10 600	25 500

6. BIBLIOGRAPHY

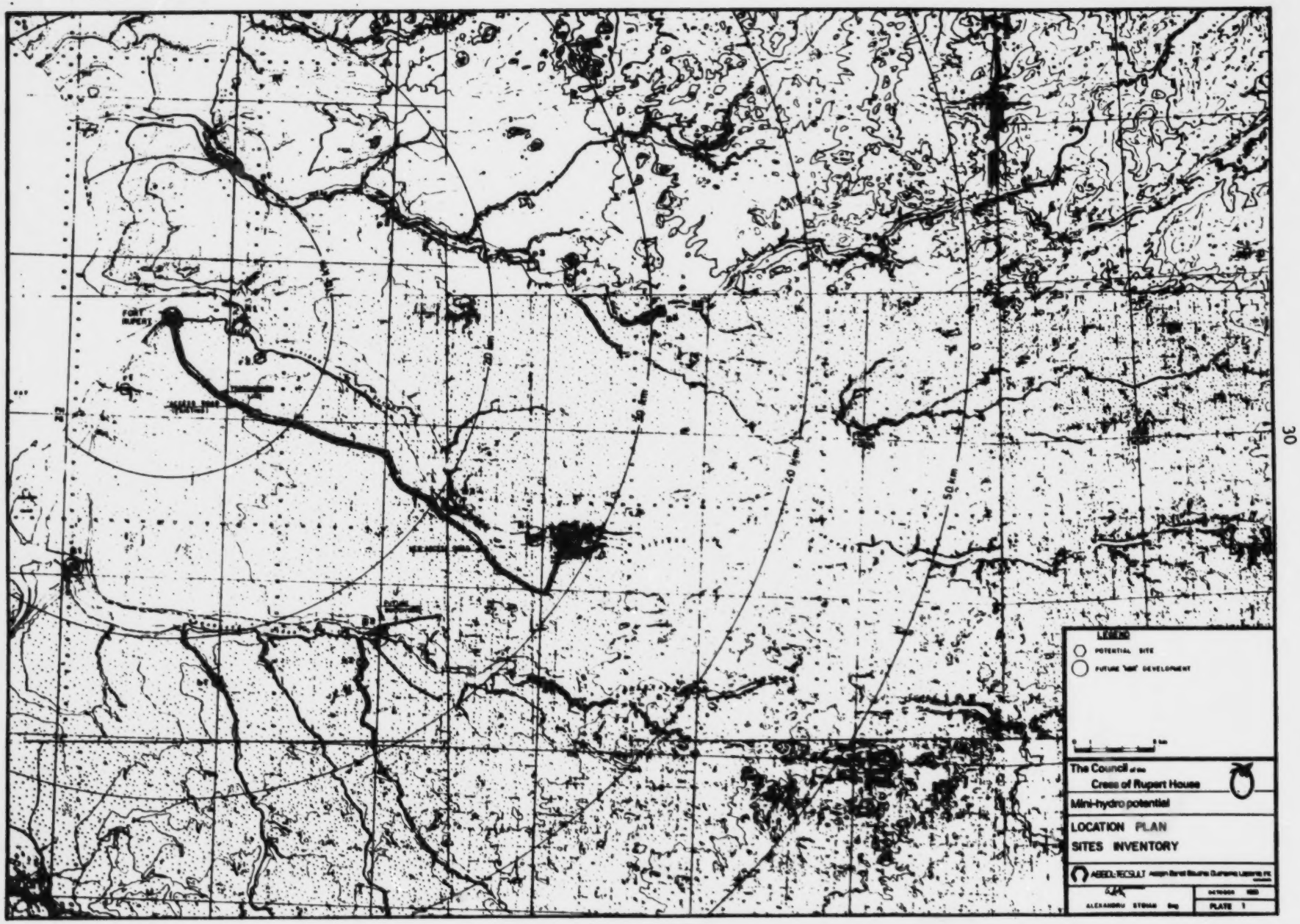
1. Crippen Consultants "Micro hydro" vol. 2, Oct. 1980.

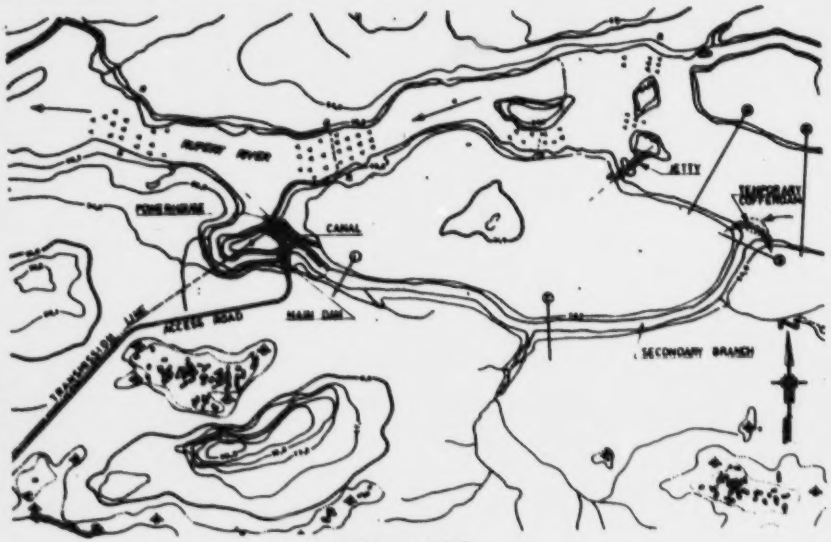
2. Ministère des Richesses Naturelles: "Superficies des bassins versants du Québec", 1970.

3. Ministère de l'Environnement: "Annuaire hydrologique 1980-1981", Québec 1983.

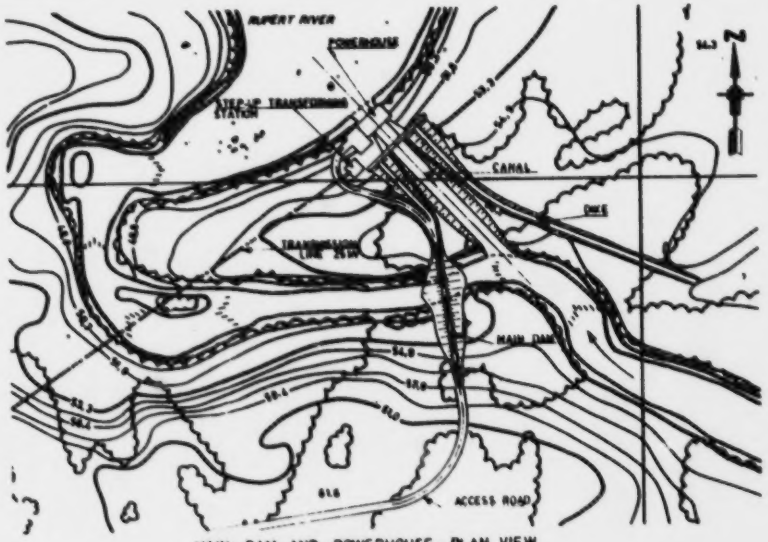
4. SEBJ "Estuaire des Rivières Broadback et Rupert, Études des changements hydrauliques", January 1980.

5. SEBJ: "Études des régimes des glaces", 1978.

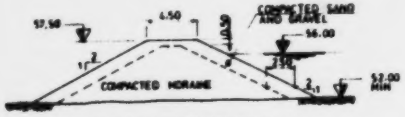

LEGEND
POTENTIAL SITE
FUTURE "MINI" DEVELOPMENT
The Council of the
Cree of Rupert House
Mini-hydro potential
LOCATION PLAN
SITES INVENTORY
PLATE 1



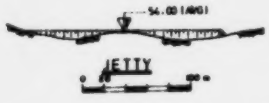
GENERAL LAYOUT



MAIN DAM AND POWERHOUSE - PLAN VIEW

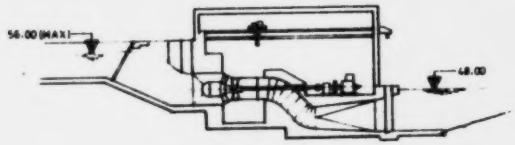


MAIN DAM CROSS-SECTION

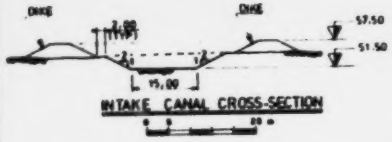


JETTY

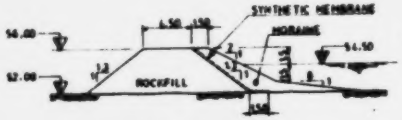
JETTY CROSS-SECTION



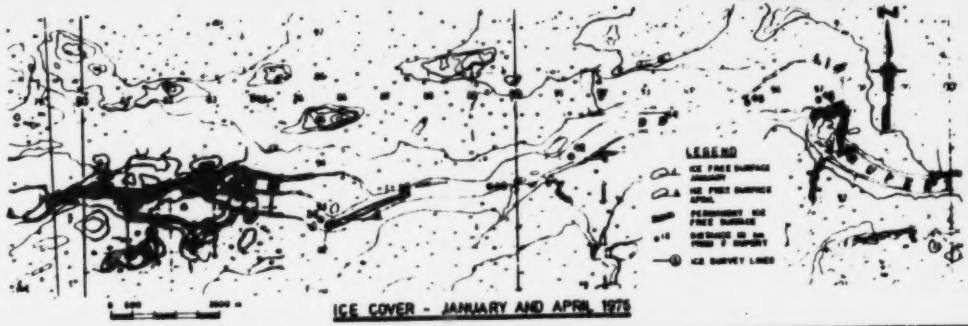
POWERHOUSE CROSS-SECTION



INTAKE CANAL CROSS-SECTION



COFFERDAM CROSS SECTION



ICE COVER - JANUARY AND APRIL 1975

NOTE DETAILS SHOW 1 NW ALTERNATIVE

The Council of the Cree of Rupert House

Mini-hydro potential

FS - GENERAL LAYOUT
DETAILS
ICE COVER CARTOGRAPHY

PLATE 3

ANNEX A - SITE INVESTIGATION DATA SHEETS

SITE INVESTIGATION DATA SHEET - "r1"

A. GENERAL DATA

1. Location

Latitude	: 5 701 650 N
Longitude	: 653 720 E
River	: POUGET
Dist. from mouth	: 1,5 km
Dist. from Rupert House	: 5,5 km

2. Elevation (from mean sea level) : 3.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: NOT NECESSARY
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by : Dpt. E.M.R. Canada and Min. Terres et Forêts

Scale	: 1:50000, 1:12000
Longitudinal profile of the river	: NONE

2. Aerial Photography

Prepared by	: Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale	: 1:15840
No. photo	: Q 68146-233 to 235

3. Geology

Photo-interpretation by	: SEBJ
Detailed investigation	: N/A

4. Hydrology

Catchment area (km2)	: 75 km^2
Gauge No	: NONE
Distance from site	: N/A
Period of existing streamflow records	: N/A
Firm flow	: MINIMAL
Ice formation observation	: N/A

C. NOTES FROM FIELD INSPECTION

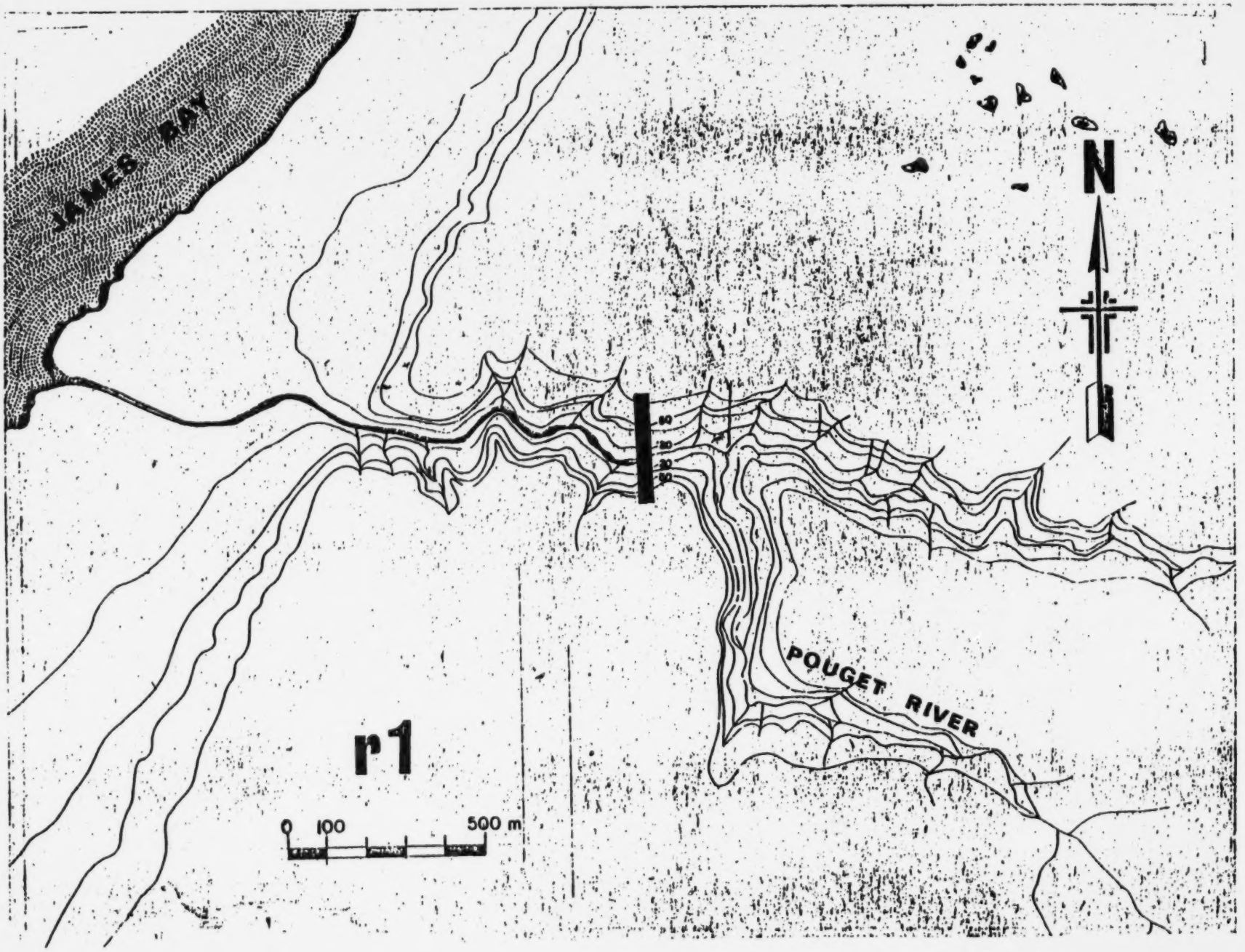
1. General Impression : Aerial view only, limited potential (small catchment area, no flow during the winter)

2. Type of scheme : Dam, reservoir, powerstation at the toe of the dam

3. Geological aspects : Terrain heaviley covered with clay, signs of local instability (fresh slides)

4. Gross head available: 15 m

5. Power available : insignificant


JAMES BAY
N
POUGET RIVER
r1
0 100 500 m

SITE INVESTIGATION DATA SHEET - "r2"

A. GENERAL DATA

1. Location

Latitude	: 5 701 650 N
Longitude	: 653 720 E
River	: Left bank Rupert River affluent
Dist. from mouth	: 1,0 km
Dist. from Rupert House	: 6 km

2. Elevation (from mean sea level) : 10.0 m

3. Access

Permanent Road	: Passing by at 3,5 km
Winter Road	: N/A
Bridge	: NOT NECESSARY
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dpt. E.M.R. Canada and Min. Terres et Forêts

Scale	: 1:50000 and 1:12000
Longitudinal profile of the river	: N/A

2. Aerial Photography

Prepared by	: Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale	: 1:15840
No. photo	: Q 68130-217 to 218

3. Geology

Photo-interpretation by	: SEBJ
Detailed investigation	: From the NBR's R1 site

4. Hydrology

Catchment area	: 45 km^2
Gauge No	: NONE
Distance from site	: N/A
Period of existing streamflow records	: N/A
Firm flow	: Minimal
Ice formation observation	: N/A

C. NOTES FROM FIELD INSPECTION

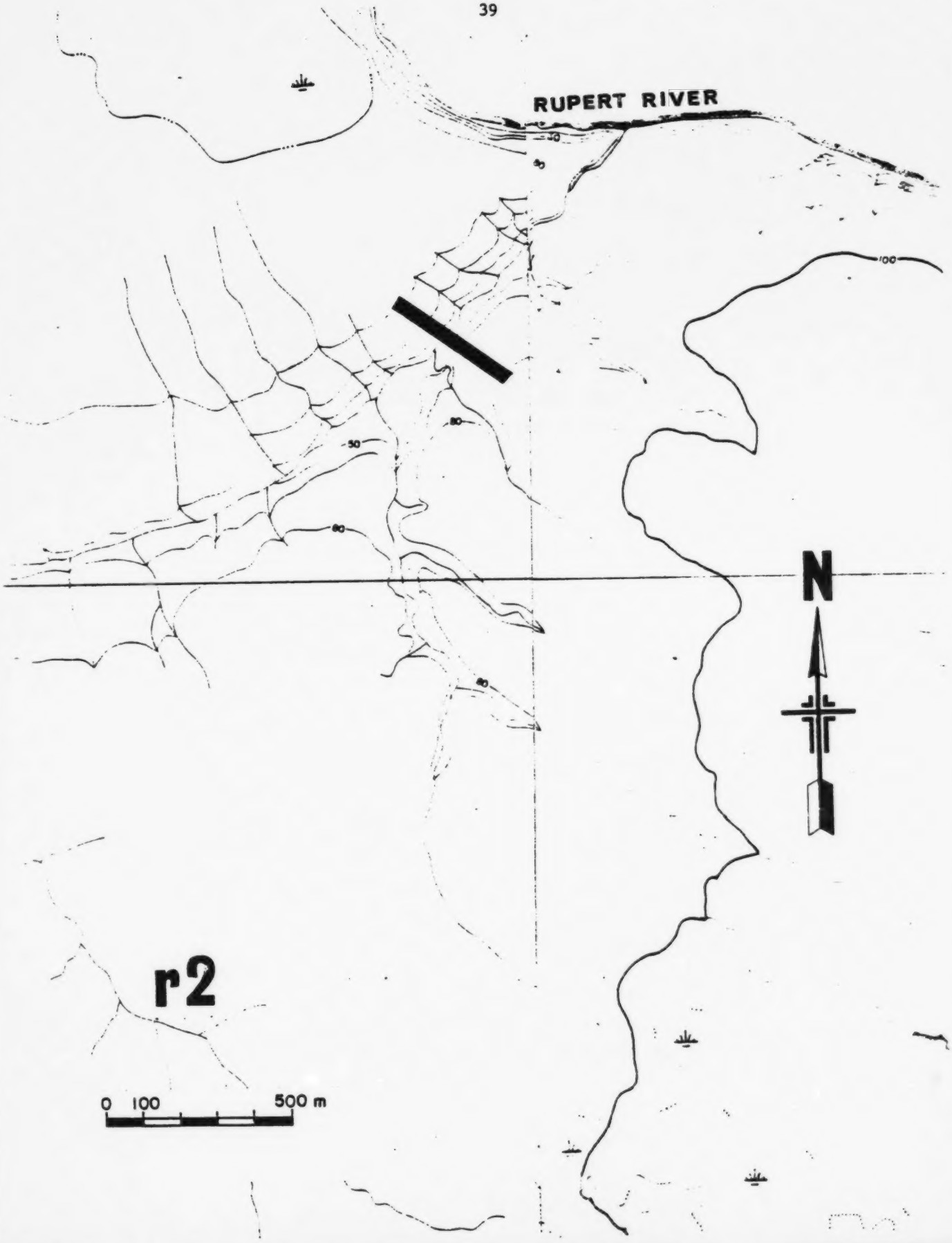
1. General Impression : Aerial view only, limited potential (small catchment area, no flow during the winter)

2. Type of scheme : Dam, reservoir, powerstation at the toe of the dam

3. Geological aspects : Terrain heaviley covered with clay, signs of local instability (fresh slides)

4. Gross head available: 15 m

5. Power available : insignificant


RUPERT RIVER
50
80
100
N
r2
0 100 500 m

SITE INVESTIGATION DATA SHEET - "r3"

A. GENERAL DATA

1. Location

Latitude	: 5 692 870 N
Longitude	: 681 190 E
River	: RUPERT
Dist. from mouth	: 32 km
Dist. from Rupert House	: 35 km

2. Elevation (from mean sea level) : 50.0 m

3. Access

Permanent Road	: Existing, to borrow pit
Winter Road	: Passing by at 3,0 km
Bridge	: NOT NECESSARY
Airport	: FORT RUPERT

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept. E.M.R. Canada and SEBJ

Scale	: 1:50000, 1:10000, 1:5000
Longitudinal profile of the river	: Available

2. Aerial Photography

Prepared by	: Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale	: 1:15840
No. photo	: Q 68121-56 to 59

3. Geology

Photo-interpretation by	: SEBJ
Detailed investigation	: From NBR's R3 site

4. Hydrology

Catchment area (km^2)	: 41 680 (1.554 residual)
Gauge No	: 081002
Distance from site	: 110 km
Period of existing streamflow records	: 28 years
Firm flow	: 340 m^3/s
Ice formation observation	: Available on Rupert River. No cross sections in the area of the proposed development

C. NOTES FROM FIELD INSPECTION

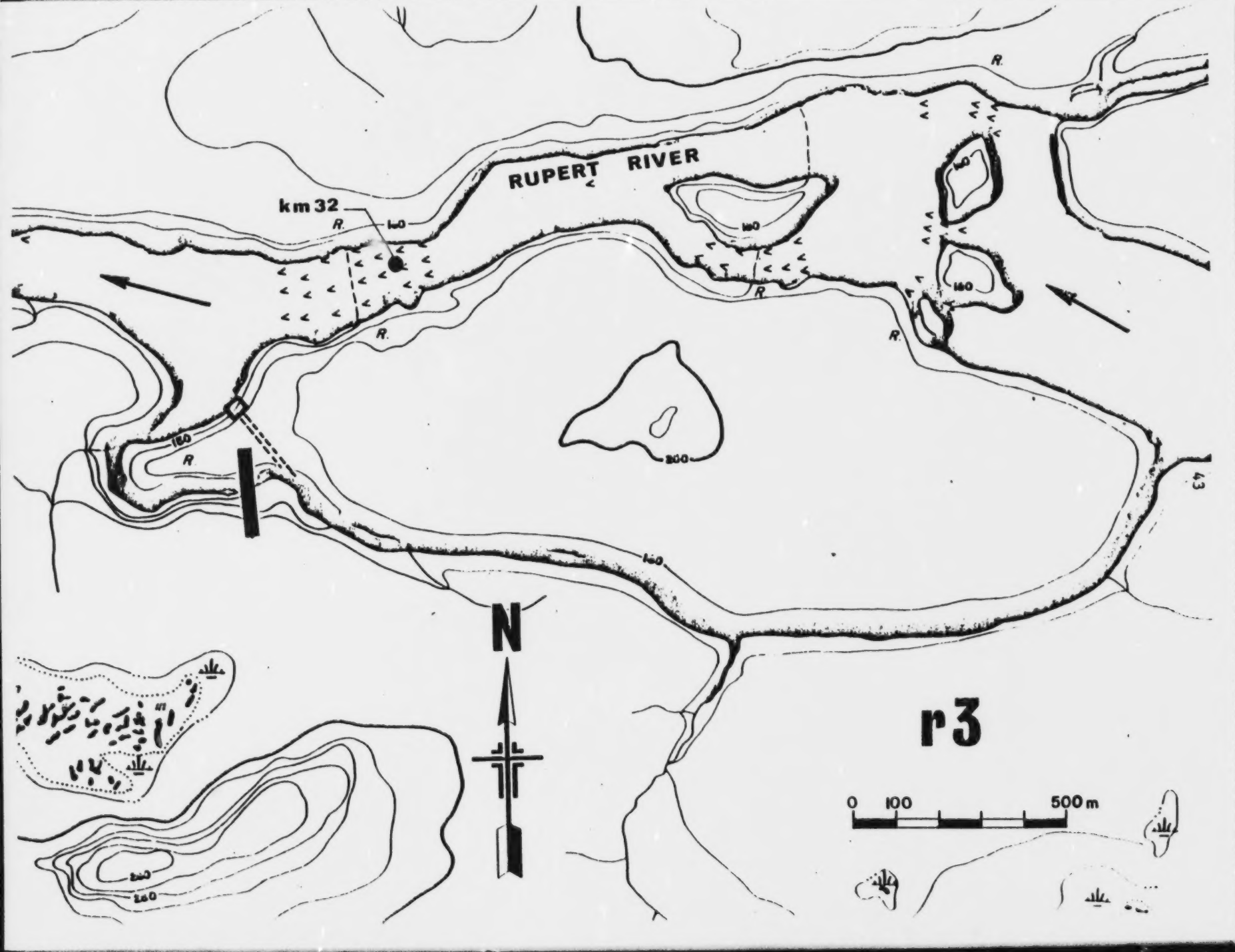
1. General Impression : Prolonged aerial inspection and landing. Walkover on the western tip of the island. Nature features favorable to a diversion scheme. Secondary branch which could be used as a power channel

2. Type of scheme : Run-of-the-river type; blockage of the secondary branch; channel across the tip of the island, by-passing the U-shaped natural stream; powerhouse in the bay of the main river, km 32

3. Geological aspects : Rock outcrops along the main river banks; rock control at the downstream extremity of the secondary branch which flows through a clay terrace

4. Gross head available: 6 - 8 m

5. Firm power available: 15 MW


RUPERT RIVER
km 32
R.
160
200
N
r3
0 100 500 m
43

SITE INVESTIGATION DATA SHEET - "p1"

A. GENERAL DATA

1. Location

Latitude	: 5 714 460 N
Longitude	: 661 740 E
River	: PONTAX
Dist. from mouth	: 10,0 km
Dist. from Rupert House	: 10 km

2. Elevation (from mean sea level) : 5.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada
Scale	: 1:50000

Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68135-199 to 200

3. Geology

Photo-interpretation by : NONE
Detailed investigation : NONE

4. Hydrology

Catchment area : 8130 km^2
Gauge No : 081101
Distance from site : 50 km
Period of existing streamflow records : 6 years
Firm flow : 13.0 m^3/s
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

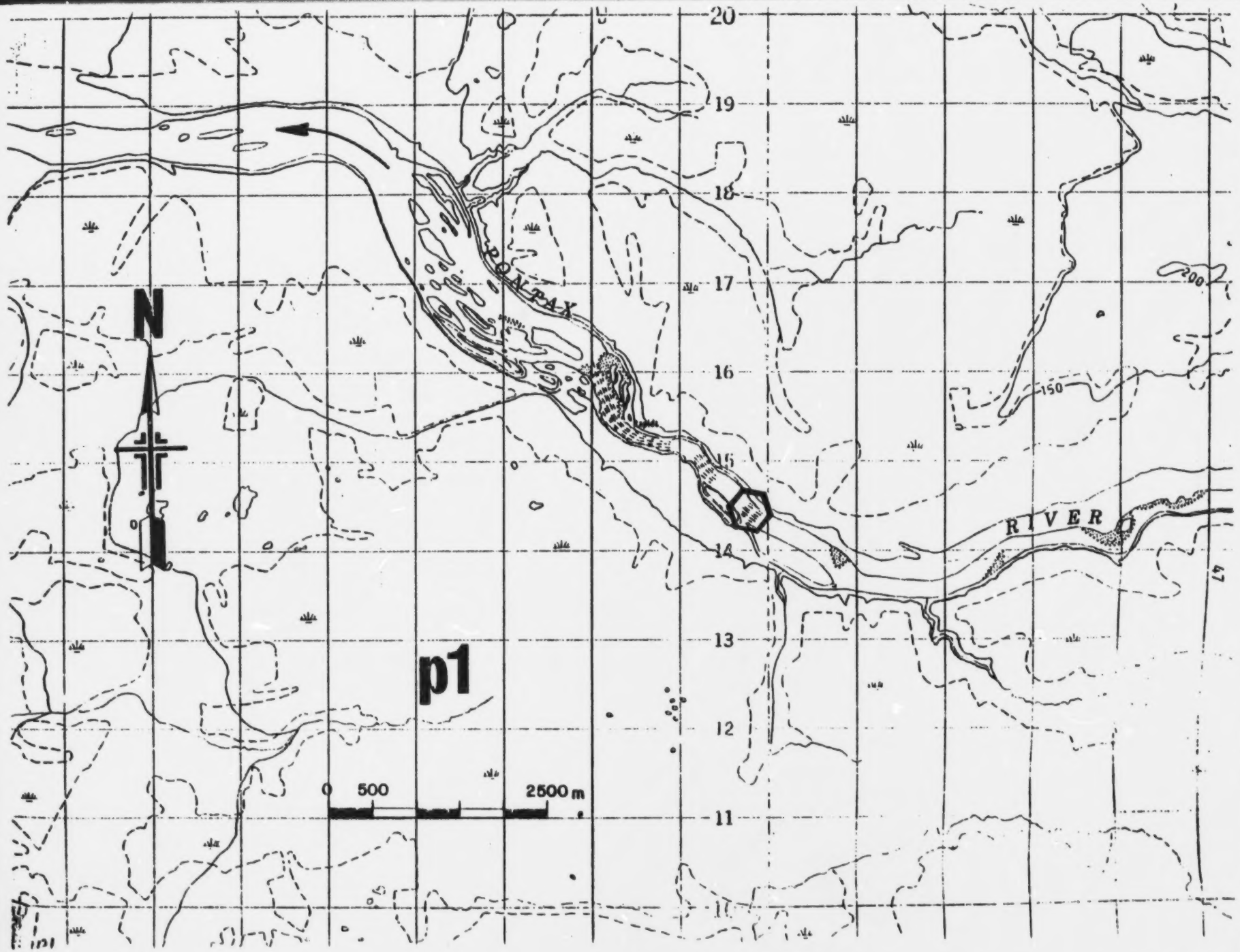
1. General Impression : Aerial view only, wide river bed, relatively gentle longitudinale slope, very long diversion needed, could be influenced by James Bay tide

2. Type of scheme : Run-of-the-river type; weir across the river, very long diversion channel to be excavated on the left bank

3. Geological aspects : Rock control apparent in the rapids

4. Gross head available: 3 - 4 m

5. Firm power available: 300 kW


20
19
18
17
16
15
14
13
12
11
PONPAX
RIVER
200
150
N
p1
0 500 2500 m

SITE INVESTIGATION DATA SHEET - "p2"

A. GENERAL DATA

1. Location

Latitude	: 5 713 250 N
Longitude	: 670 070 E
River	: PONTAX
Dist. from mouth	: 18,5 km
Dist. from Rupert House	: 22,0 km

2. Elevation (from mean sea level) : 15.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada
Scale	: 1:50000

Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68135-64 to 66

3. Geology

Photo-interpretation by : NONE
Detailed investigation : NONE

4. Hydrology

Catchment area : 7690 km^2
Gauge No : 081101
Distance from site : 42,5 km
Period of existing streamflow rec. : 6 years
Firm flow : 12.6 m^3/s
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

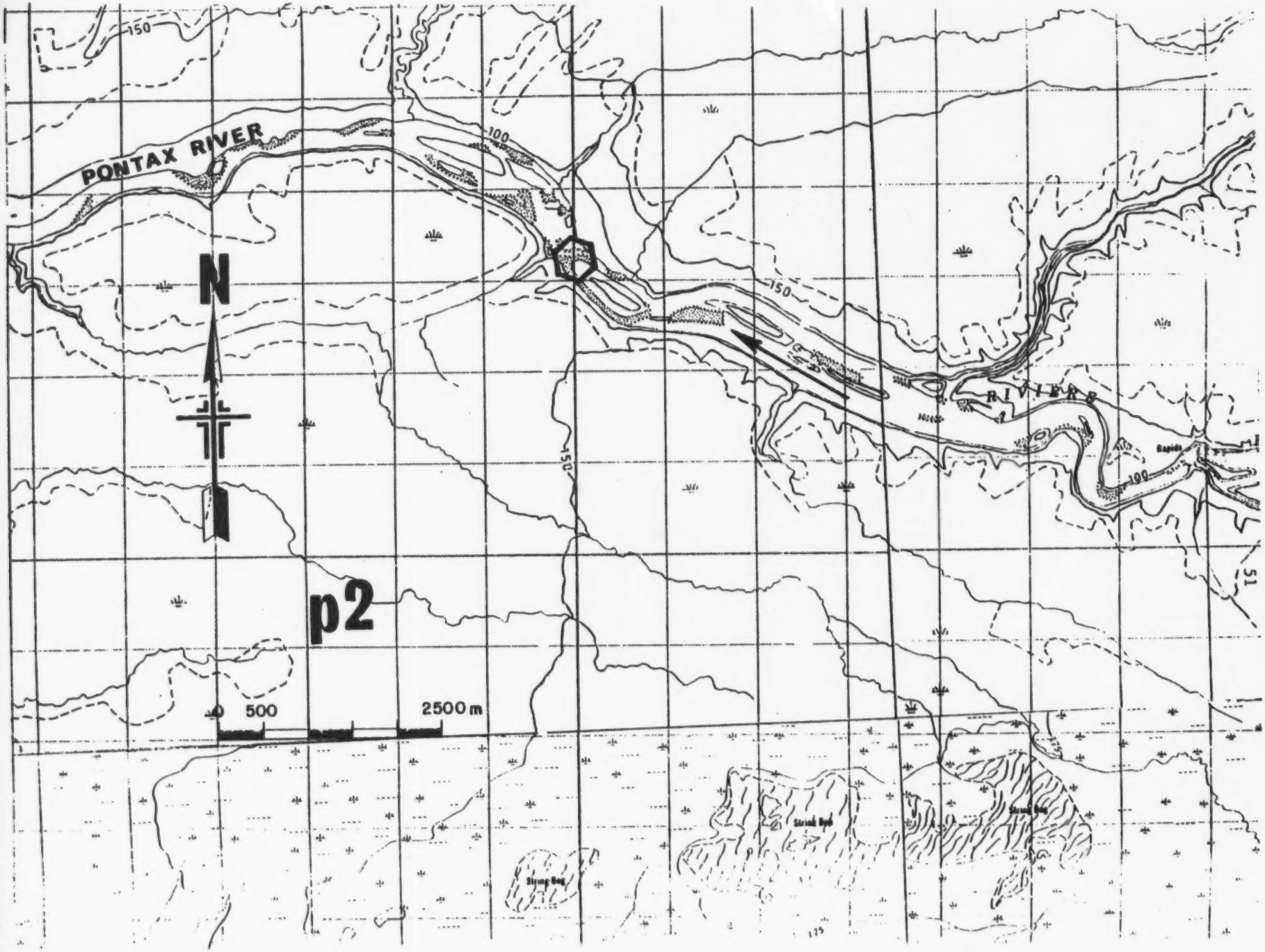
1. General Impression : Aerial view only, wide river bed, relatively gentle longitudinale slope, very long diversion needed

2. Type of scheme : Run-of-the-river type; weir across the river, very long diversion channel to be excavated on the left bank

3. Geological aspects : Rock control apparent in the rapids

4. Gross head available: 4 - 5 m

5. Firm power available: 350 kW


PONTAX RIVER
150
100
150
150
N
p2
0 500 2500 m
RIVIERE
100
51

SITE INVESTIGATION DATA SHEET - "p3"

A. GENERAL DATA

1. Location

Latitude	: 5 710 280 N
Longitude	: 678 790 E
River	: PONTAX
Dist. from mouth	: 27,5 km
Dist. from Rupert House	: 15,0 km

2. Elevation (from mean sea level) : 30.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada
Scale	: 1:50000

Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by	: Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale	: 1:15840
No. photo	: Q 68137-51 to 53

3. Geology

Photo-interpretation by	: NONE
Detailed investigation	: NONE

4. Hydrology

Catchment area	: 7250 km^2
Gauge No	: 081101
Distance from site	: 32,5 km
Period of existing streamflow rec.	: 6 years
Firm flow	: 11.9 m^3/s
Ice formation observation	: N/A

C. NOTES FROM FIELD INSPECTION

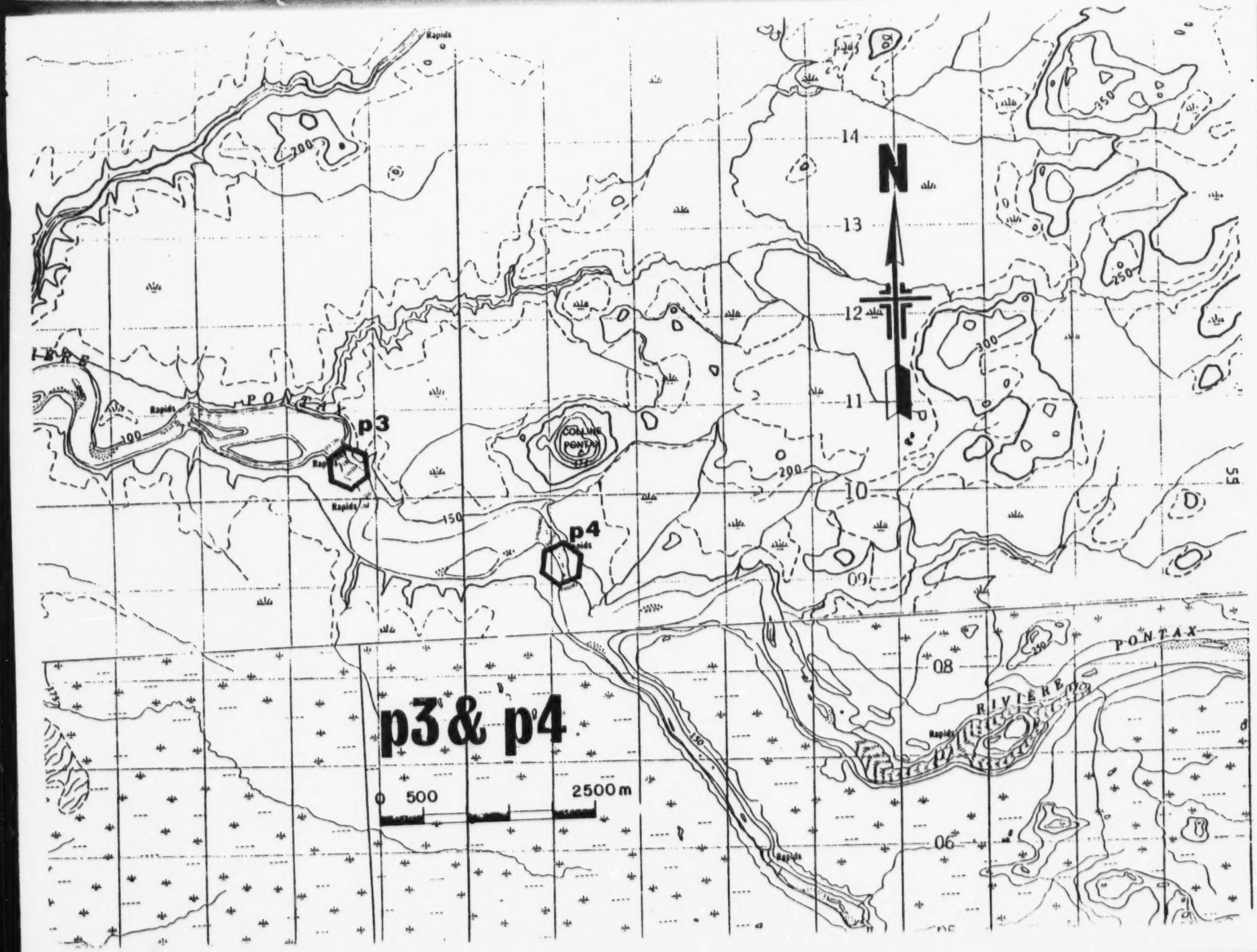
1. General Impression : Aerial view only, wide river bed, gentle longitudinal slope, long diversion needed, low potential

2. Type of scheme : Run-of-the-river type; weir across the river, long diversion channel to be excavated on the left bank

3. Geological aspects : Rock control apparent in the rapids

4. Gross head available: 5 - 6 m

5. Firm power available: 450 kW


p3
p4
p3 & p4
0 500 2500 m
N
14
13
12
11
10
09
08
06
PONTAX
RIVIERE
Rapids
100
150
200
250
300

SITE INVESTIGATION DATA SHEET - "p4"

A. GENERAL DATA

1. Location

Latitude	: 5 709 270 N
Longitude	: 681 140 E
River	: PONTAX
Dist. from mouth	: 31,0 km
Dist. from Rupert House	: 25 km

2. Elevation (from mean sea level) : 35.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada
Scale	: 1:50000

Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by	: Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale	: 1:15840
No. photo	: Q 68137-51 to 53

3. Geology

Photo-interpretation by	: NONE
Detailed investigation	: NONE

4. Hydrology

Catchment area	: 7200 km^2
Gauge No	: 081101
Distance from site	: 29,0 km
Period of existing streamflow rec.	: 6 years
Firm flow	: 11.8 m^3/s
Ice formation observation	: N/A

C. NOTES FROM FIELD INSPECTION

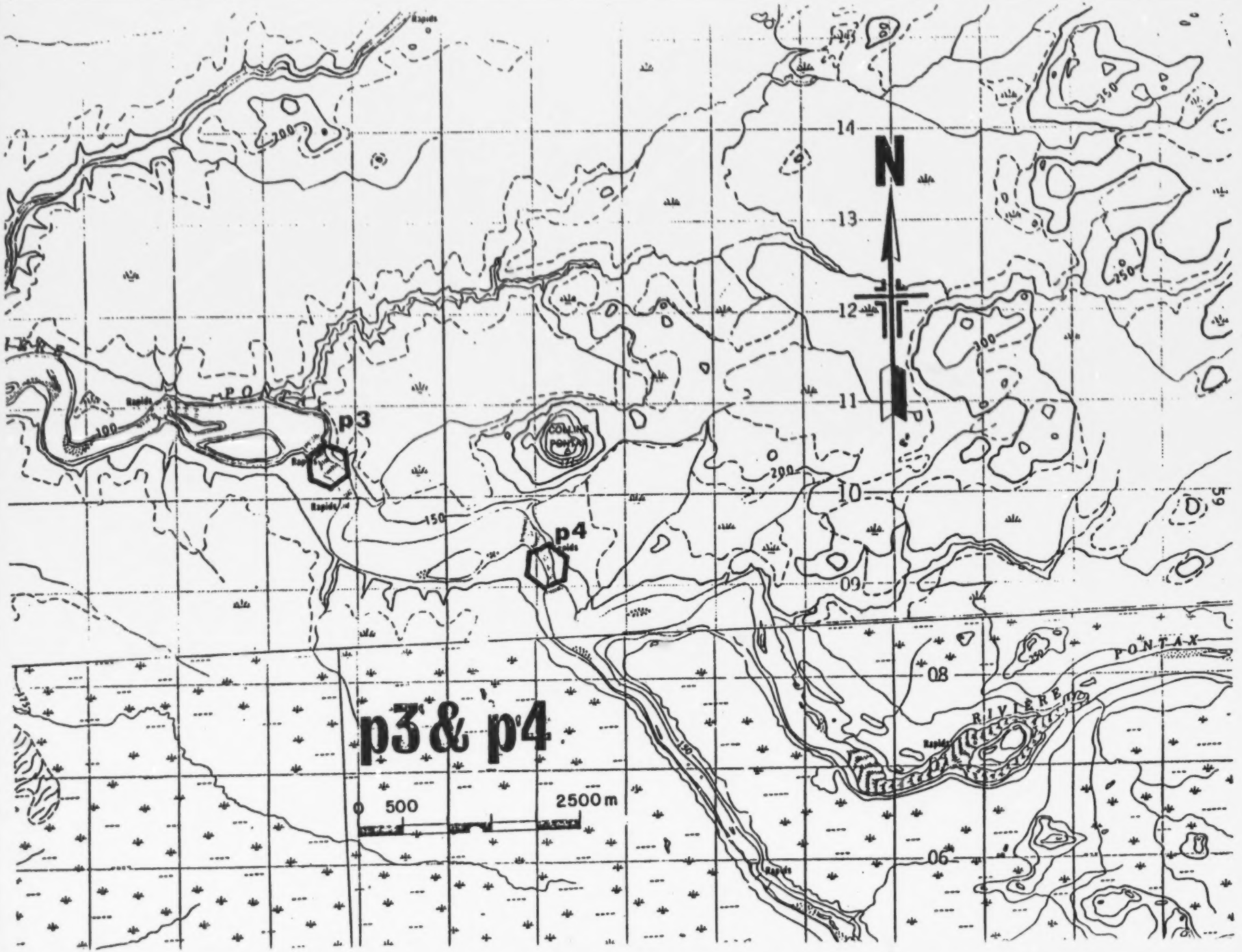
1. General Impression : Aerial view only, narrower river bed than "p1", "p2" and "p3", shorter diversion needed

2. Type of scheme : Run of the river type, weir across the river, diversion channel to be excavated on left bank (possibly through rock)

3. Geological aspects : Rock control apparent in the rapids

4. Gross head available: 5 - 6 m

5. Power available : 450 kW


p3
p4
p3 & p4
N
14
13
12
11
10
09
08
06
200
150
100
300
250
RIVIERE
PONTAX
0 500 2500 m

SITE INVESTIGATION DATA SHEET - "p5"

A. GENERAL DATA

1. Location

Latitude	: 5 707 690 N
Longitude	: 687 080 E
River	: PONTAX
Dist. from mouth	: 38 km
Dist. from Rupert House	: 30 km

2. Elevation (from mean sea level) : 55.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER and X-103
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by : Dept E.M.R. - Canada

Scale : 1:50000
Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68124-216 to 218

3. Geology

Photo-interpretation by : NONE
Detailed investigation : NONE

4. Hydrology

Catchment area : 6320 km^2
Gauge No : 081101
Distance from site : 22 km
Period of existing streamflow rec. : 6 years
Firm flow : 10.4 m^3/s
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

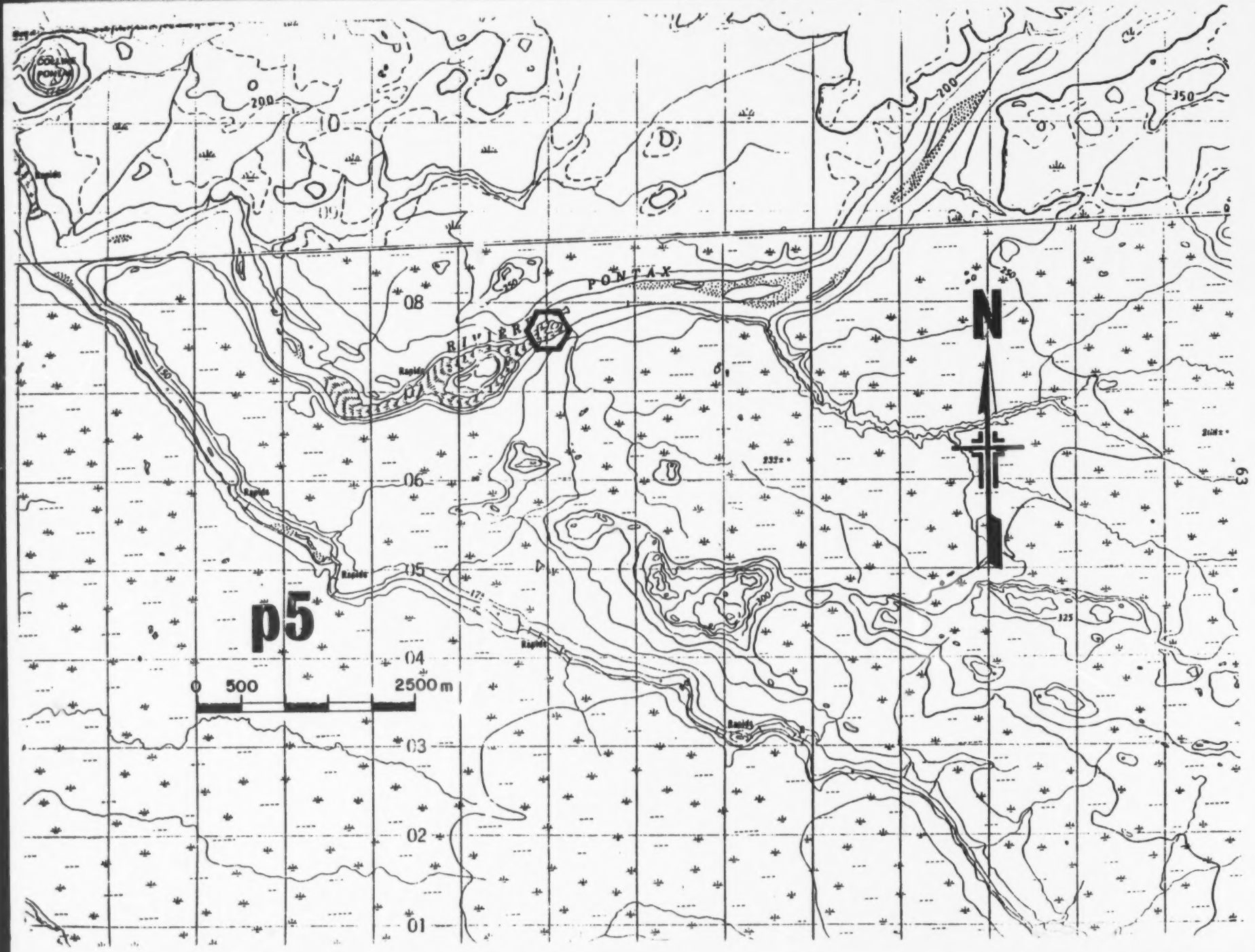
1. General Impression : Aerial inspection and landing, favorable location due to the presence of the island

2. Type of scheme : Run-of-the-river type, development along the left side branch

3. Geological aspects : Rock control apparent in the rapids

4. Gross head available: 6 - 7 m

5. Firm power available: 475 kW


PONTAX
RIVER
N
p5
0 500 2500 m
08
06
05
04
03
02
01
Rapids

SITE INVESTIGATION DATA SHEET - "p6"

A. GENERAL DATA

1. Location

Latitude	: 5 712 600 N
Longitude	: 700 870 E
River	: PONTAX
Dist. from mouth	: 61 km
Dist. from Rupert House	: 45 km

2. Elevation (from mean sea level) : 65.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS RUPERT RIVER and X-103
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by : Dept E.M.R. - Canada

Scale : 1:50000
Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68135-83 to 84

3. Geology

Photo-interpretation by : NONE
Detailed investigation : NONE

4. Hydrology

Catchment area : 6090 km^2
Gauge No : 081101
Distance from site : 0 km
Period of existing streamflow rec. : 6 years
Firm flow : 10.0 m^3/s
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

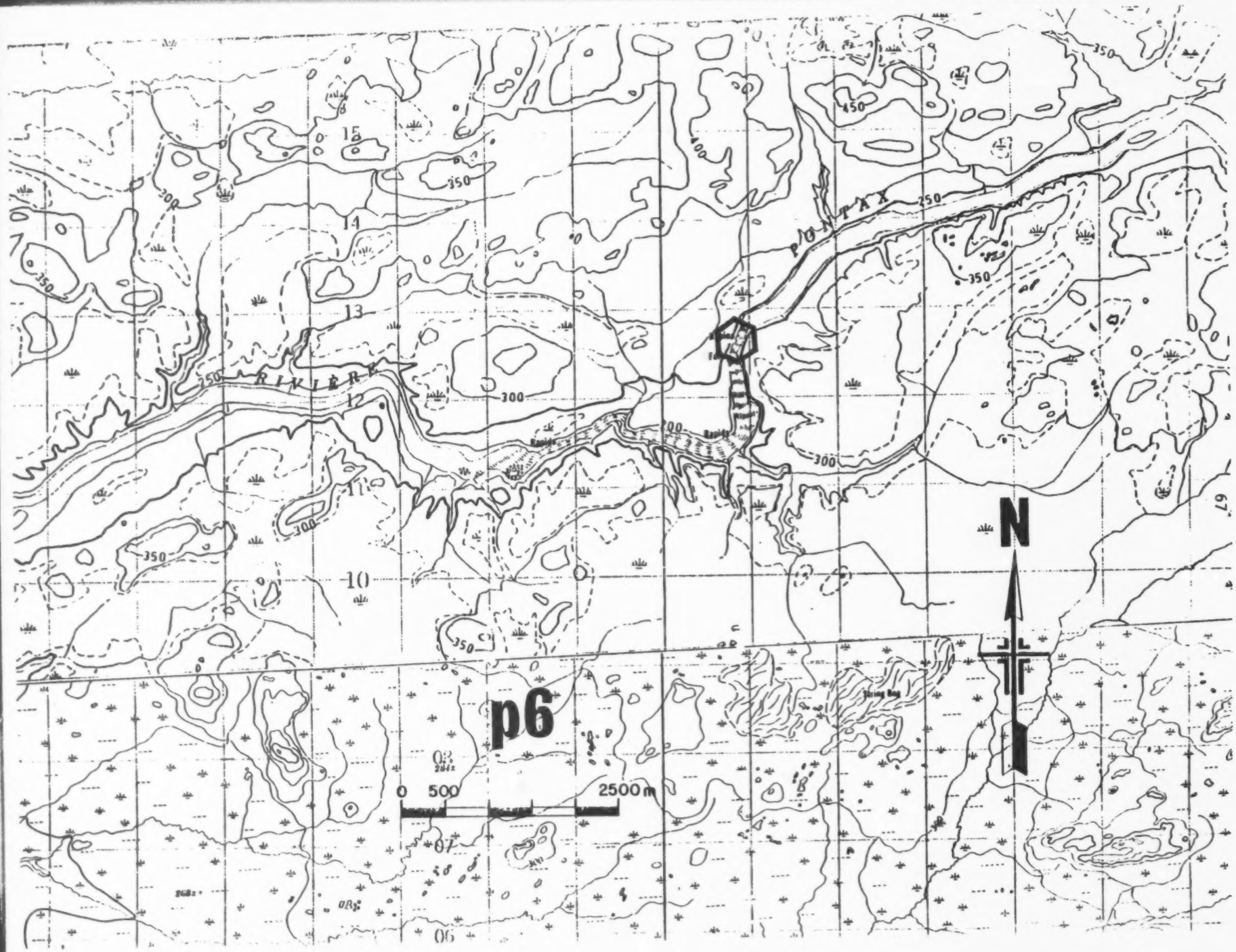
1. General Impression : Aerial inspection and landing, very favorable location with a concentrated drop which could reach 15 m

2. Type of scheme : Run-of-the-river type. Power-house immediatly dowstream from the falls

3. Geological aspects : Very sound foundation. Rock covering the entire area

4. Gross head available: 15 m

5. Firm power available: 1 MW


p6
N
0 500 2500 m
RIVIERE
POINTAX
15
14
13
12
11
10
350
300
250
400
450

SITE INVESTIGATION DATA SHEET - "b1"

A. GENERAL DATA

1. Location

Latitude	: 5 682 940 N
Longitude	: 660 450 E
River	: LEPALIER
Dist. from mouth	: 4,5 km
Dist. from Rupert House	: 23 km

2. Elevation (from mean sea level) : 25.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS BROADBACK RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada AND SEBJ

Scale : 1:50000 AND 1:10000
Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68197-30 and 31

3. Geology

Photo-interpretation by : SEBJ
Detailed investigation : from NBR's B1 site

4. Hydrology

Catchment area : 200 km^2
Gauge No : 080801
Distance from site : 90 km
Period of existing streamflow rec. : 20 years
Firm flow : N/A
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

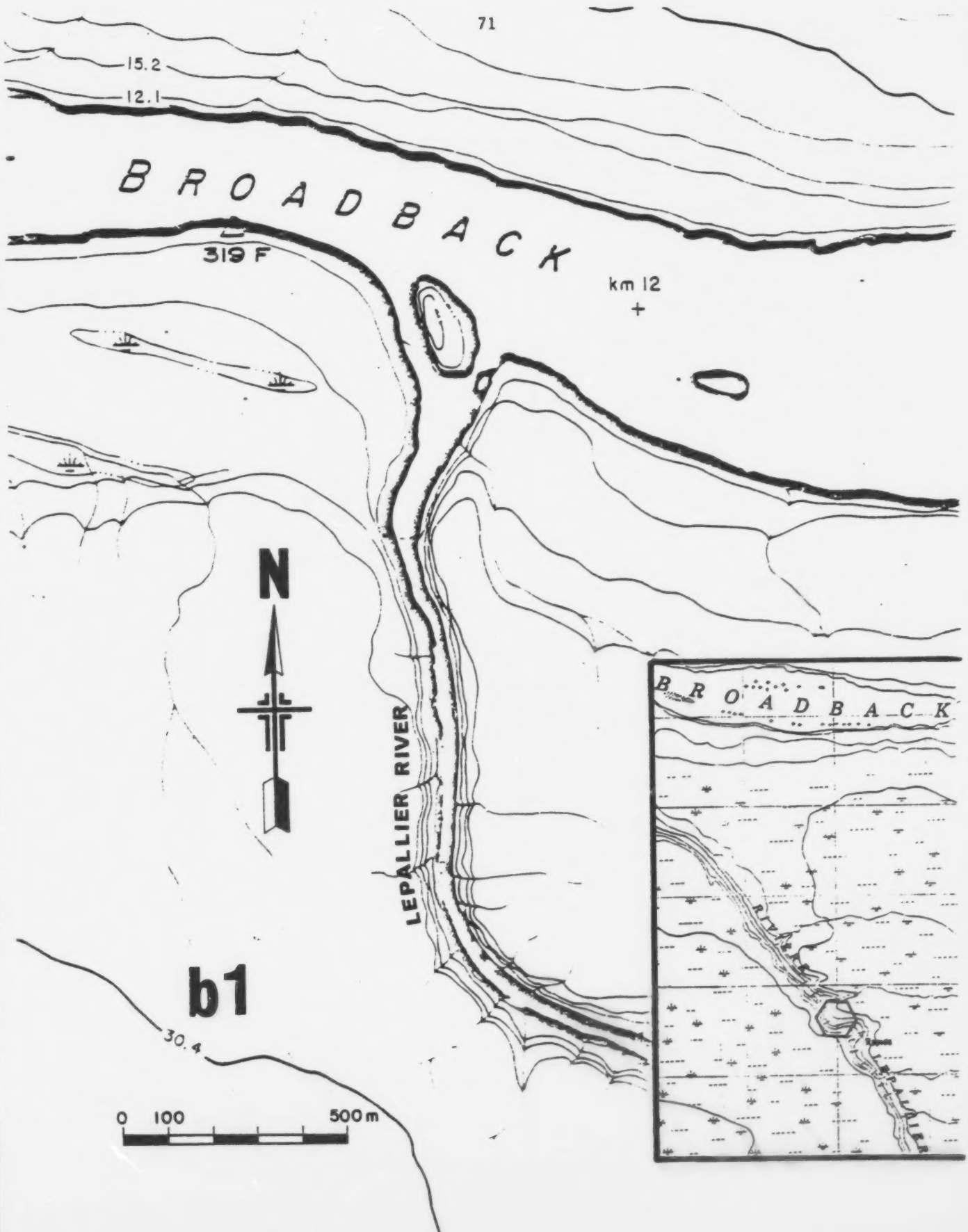
1. General Impression : Aerial view only, relatively small river, influence of future "B1" reservoir

2. Type of scheme : Run-of-the-river type; power-house at the toe of the dam

3. Geological aspects : Clay filled banks, fresh slides

4. Gross head available: 10,0 m (to future "B1" elevation)

5. Firm power available: limited potential


15.2
12.1
BROADBACK
319 F
km 12
+
N
LEPALLIER RIVER
b1
30.4
0 100 500 m
BROADBACK

SITE INVESTIGATION DATA SHEET - "b2"

A. GENERAL DATA

1. Location

Latitude	: 5 684 440 N
Longitude	: 668 780 E
River	: NATOUACAMISIE
Dist. from mouth	: 1,5 km
Dist. from Rupert House	: 24,5 km

2. Elevation (from mean sea level) : 25.0 m

3. Access

Permanent Road	: NONE
Winter Road	: NONE
Bridge	: ACROSS BROADBACK RIVER
Airport	: RUPERT HOUSE

4. Environmental factors

Fishing	: NONE
Hunting	: NONE
Others	: NONE

B. AVAILABLE INFORMATION

1. Topography

Maps prepared by	: Dept E.M.R. - Canada AND SEBJ

Scale : 1:50000 AND 1:10000
Longitudinal profile of the river : N/A

2. Aerial Photography

Prepared by : Min. des Terres et Forêts, Serv. de la cartographie - Québec
Scale : 1:15840
No. photo : Q 68147-37 and 38
Q 68148-239 and 240

3. Geology

Photo-interpretation by : SEBJ
Detailed investigation : from NBR's B2 site

4. Hydrology

Catchment area : 650 km^2
Gauge No : 080801
Distance from site : 80 km
Period of existing streamflow rec. : 20 years
Firm flow : N/A
Ice formation observation: N/A

C. NOTES FROM FIELD INSPECTION

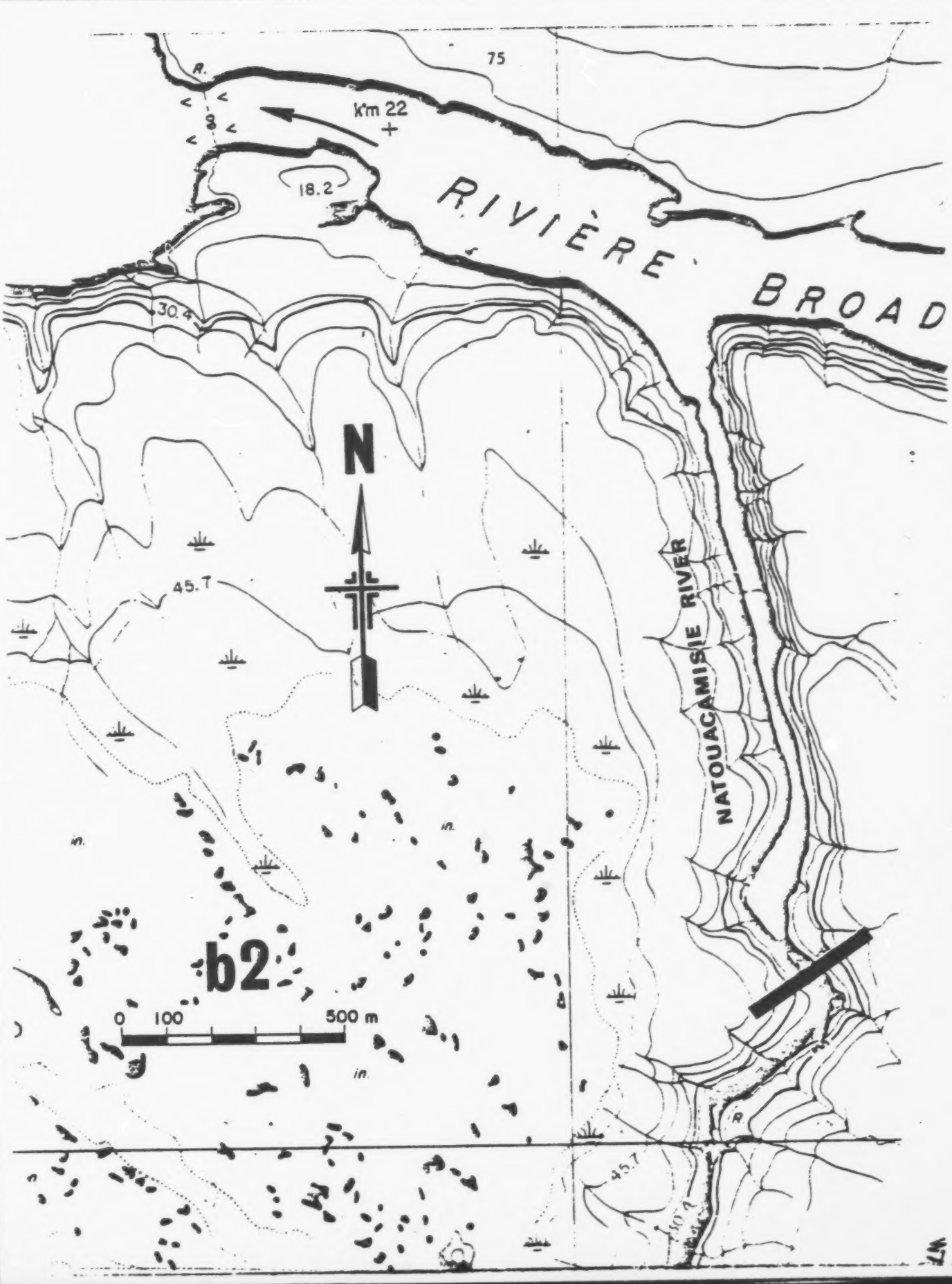
1. General Impression : Aerial view only, relatively small river, influence of future "B1" reservoir

2. Type of scheme : Run-of-the-river type; power-house at the toe of the dam

3. Geological aspects : Clay filled banks, fresh slides

4. Gross head available: 10,0 m (to future "B1" elevation)

5. Firm power available : limited potential


R.
75
km 22
18.2
RIVIÈRE BROAD
30.4
N
45.7
NATOUAGAMISIE RIVER
b2
0 100 500 m
45.7

ANNEX B - ADDITIONAL INFORMATION

ABBDL-TECSULT

Asselin Benoit Boucher
Ducharme Lapointe Inc.
experts-conseils/consultants

85, RUE STE-CATHERINE OUEST, MONTRÉAL, QUÉBEC, CANADA H2X 3P4
TÉL.: (514) 287-8500 CABLE: "SULTEC" TÉLEX: 055-60122

April 17, 1984

Chief Bill Namagoose
Rupert House Band Council
Rupert House
James Bay (Quebec)
J0N 1R0

27 AVR. 1984

SUBJECT: Final comments related to the
Pre-feasibility report
Our file: 2082

Dear Sir:

Please find enclosed a comprehensive list of answers to all the comments received to date on our final report, either directly from you or from Energy, Mines and Resources Canada. A verbal presentation on the matter was made on April 12, 1984 in the Montreal branch of the Conservation and Renewable Energy Office, in front of representatives of the Cree Regional Authority, your consultants and federal authorities.

We consider now that our mandate regarding the pre-feasibility study on the mini-hydro potential around Rupert House is fully completed.

The positive answer already obtained from the 1984 ice investigation program and the final report on the energy study under advanced preparation by COGESULT are the two prerequisites for the next step, the feasibility study of the mini-hydro power source.

We hope to be asked to continue our studies as soon as you made the choice of your best energy sources for Rupert House.

A. Stoian
Project Engineer

c.c.: M. Lamanque, Energy, Mines & Resources
Y. Magnan, Indian and Northern Affairs
G. Wapachee, Cree Regional Authority
V. K. Handa, Waterloo University
M. Desrochers, ABBDL
P. Tremblay, ABBDL

Encl.

MINI HYDRO POTENTIAL - RUPERT HOUSE
PRE-FEASIBILITY STUDY
FINAL COMMENTS AND ANSWERS

Q. No. 1: If the residual flow is 343 m^3/sec. after diversion of the Rupert River (if the N.B.R. project is built), then how does Tecsult arrive at an output of 1 MW under these conditions?

A. No. 1: If the NBR Complex is built and the Rupert River is diverted, the mean monthly residual flows available downstream of the diversion section are shown in Table 5 of our report (p. 18). We do not identify in it the 343 m^3/s value mentioned in your question but it can be seen instead that in January, February, March and April, the residual flows could be well under the 15 to 18 m^3/s needed to assure at r-3, 1 MW of firm power. The run-of-the-river operation will not be feasible anymore.

To compensate, it is suggested to create a reservoir with an active storage of around 25,000,000 m^3 by adding an impervious element to the weir that SEBJ has to build as a mitigating measure related to the NBR Complex (p. 14 of our report). The location of this weir coincide with the jetty provided for the r-3 mini-powerhouse (see plate 2 of our report).

The feasibility study will show if, based on the real energy demand, the needed compensating effect will be on a daily, weekly or monthly basis.

Q. No. 2: Could Tecsult provide the formula it uses to calculate "firm power"?

A. No. 2: The formula used for establishing the available power is the classic one:

$$P = 9.81 \times \eta \times Q \times H$$

where

P : available power at the site, in kW

η : overall efficiency of the installation (0.9)

Q : flow in m^3/s

H : net head, in m

For the 1 MW basic power requirement, a 15 to 18 m^3/s flow is needed. For the 5 MW capacity, the requested flow goes up to 75 - 90 m^3/s but still well below the March minimal value of 339 m^3/s.

In computing the firm power, the flow considered should be available 95% of the time.

Q. No. 3: At site r-2 there is 15 m of head. While it is stated in the report that the catchment basin of this site is too small, is it not possible to divert water from upstream on the Rupert River to overcome this limitation?

A. No. 3: At the r-2 site, the headwater level is around elevation 20. The diversion from the Rupert River should be made for this reason somewhere in the R-2 rapids area, some 15 km upstream from the investigated mini-hydro site (see plate 1 of our report).

Q. No. 4: What would the approximate cost of such a diversion be?

A. No. 4: Apart from the high cost of a 15 km long channel or conduit for the diverted flow, the intake will have to be built in the R-2 rapids area where the frazil accumulation was revealed in 1972 (p. 11 of our report). Both aspects are a strong enough reason for eliminating such a scheme.

Q. No. 5: Are there any frazil ice studies for the area above the R-3 site? If so, can Tecsult supply these, or a summary of them? If not, then could such measurements be done at the same time as the r-3 frazil ice measurements?

A. No. 5: Tecsult has already made a study of the existing ice cover conditions to determine the probable water levels at the construction sites of the powerhouses considered by SEBJ for the NBR Hydro Complex (Rupert Alternative). (Reference: SEBJ Complexe NBR - Rapport final - Etude des Régimes de glace Tome 1 - Résultats Rivière Rupert, ABBDL experts-conseils, septembre 1978).

This study was based on the analysis of Landsat satellite pictures for the determination of extension of the ice cover under natural conditions and on theoretical calculations. River cross-sections were not measured for frazil ice investigation. Frazil production rates were calculated by mathematical equations. The study showed that frazil production is possible above R-3 at the following locations:

- km 66 - 68 (R-5)
- km 79 - 85 (R-7)
- km 102 - 104
- km 107 - 115 (R-8A)

Frazil generated in the rapids accumulated downstream under the solid ice cover. Under natural conditions these accumulations of frazil do not cause any sensible raise in the water levels even if frazil can block a large portion of the river cross-section at some places but can be troublesome for small hydro intake structures.

Upstream of r-3 the measurements could be done but are not recommended as the cost of the power line and the access road become prohibitive when the location of the mini-hydro project is so remote.

During the months of January and March 1984, two investigations on ice conditions at r-3 were carried out and the results strongly indicate that the Kaopaskuan Sibostak area where the r-3 mini-powerhouse is located, has an almost frazil-free condition.

Q. No. 6: The presentation of the R1, R2, R3 sites and the justification for their rejection?

A. No. 6: The R1, R2 and R3 sites are the location of three projects, part of a SEBJ Development, namely the NBR Complex (Rupert Alternative).

The axes are not favorable to mini-hydro development because some of the most important criteria for selection mentioned in our report (pages 9 and 10) are not met. The river slope is minimal, the width of the river and the shape of the stream are not favorable. Big dams, long dikes and other expensive structures are necessary for artificially creating the head.

More than that, the R1 location is affected by the James Bay tide which halves during its cycle the 4 to 5 m drop found in the rapids and the R2 location at km 24 is eliminated by the frazil accumulation revealed by the 1972 ice survey (page 11 of our report).

Q. No. 7: Update of the electrical demand for the community according to the results of the comparative energy study.

A. No. 7: The report is in advance preparation by COGESULT according to its mandate.